HOW TO BUILD
FIRST-RATE SHIP MODELS FROM KITS

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MODEL EXPO
MODEL SHIPWAYS

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PREFACE

Scratch-built ship models have a reputation for excellence. Those who build them say they are forced to think about what they're doing. Scratch building allows them to select the best materials and create true-to-scale fittings. Nevertheless, thousands of models are built from kits. Many modelers or potential modelers don't have the resources for an elaborate workshop or the time to scratch build. Furthermore, most beginners lack the confidence to scratch build a ship model. For them, pursuing the hobby via a kit is the ideal solution.

Depending on a person's knowledge and skill level, kit-built models range from a poor, sloppy job all the way to perfection. This book will help those with limited experience to achieve success and eventually build a first-rate kit model.

Building exceptional models from kits is challenging. You start with what is supplied, good or bad. Your goal is to do the best job you can, and hopefully come up with a winner. Building professional-looking wooden ship models comes with experience. Even if you have a woodworking background, ship models are unique. They require working with small scale parts, using different tools, and researching the kit's historical accuracy. While many modelers are self-taught and eventually gain the necessary experience, there is nothing like a little help along the way. This book will provide it. The information and instructions are based on my many years of experience, in addition to listening to and recording the advice of experts who have built great ship models.

One secret to building first-rate kit models is making the most out of the supplied parts. Sometimes all they require are simple modifications or inexpensive replacements. Another secret is achieving a quality finish. I'll teach you proper woodworking techniques and how the professionals sand and paint. Throughout these pages, I'll mention references (Appendix A) to improve your nautical knowledge or research capabilities. By the time you've finished the book, you'll even know how to recognize a good plan from a bad one.

Appendix B lists the major ship kit manufacturers and some designers. Appendix C defines common nautical terms used in this book and many others. Knowing them is essential to interpreting plans and instructions, or understanding what a professional modeler is talking about.

Most examples relate to building "stick and string" models; that is, old-time sailing ships. Beginners experience the most difficulty with them due to the hull's shape and how it is planked. However, I won't neglect plastic kit models or modern vessels. Whether it's an aircraft carrier or colonial sailing ship, many modeling techniques are the same. A good paint job is a good paint job, and rigging is rigging with only minor variations.

My thanks to Marc Mosko, President of Model Expo, for encouraging me to write this book, and to Scottie Dayton for editing it. Scottie edited the original *Ships in Scale* magazine (1983-1989). She is not only an excellent editor, but well versed in naval architecture and model building. Scottie is currently a contributing editor for *Seaways' Ships in Scale*. I'd also like to thank subscribers to Dr. Clayton Feldman's ship modeling e-mail list. Discussions on the list were extremely helpful in preparing this text. My special thanks to Robert Steinbrunn, John Fryant, and Al Caunitz for contributing photos of their excellent kit-built models. Finally, here's to all the experts – past and present – whose ideas I've incorporated or adapted for years.

CHAPTER 1
INSPECTING THE KIT AND GETTING STARTED

A wooden ship model kit generally contains:

- Set of plans
- Instruction manual or sheets of instructions
- Parts list printed in the manual, on the plans, or in a separate listing
- Laser-cut, die-cut, or machine-cut wooden parts
- Machine-carved wooden hull if it is a solid hull kit
- Stripwood, wooden sheets, and perhaps small wooden blocks
- Round or tapered dowels for masts and spars
- Cast britannia or brass fittings, and possibly photo etched parts
- Wooden fittings such as deadeyes and blocks
- Brass, aluminum, or steel tubing, solid rod, wire, and nails
- Pedestals, launching ways, or baseboard
- Rigging line, and perhaps sailcloth if it is a sailing ship

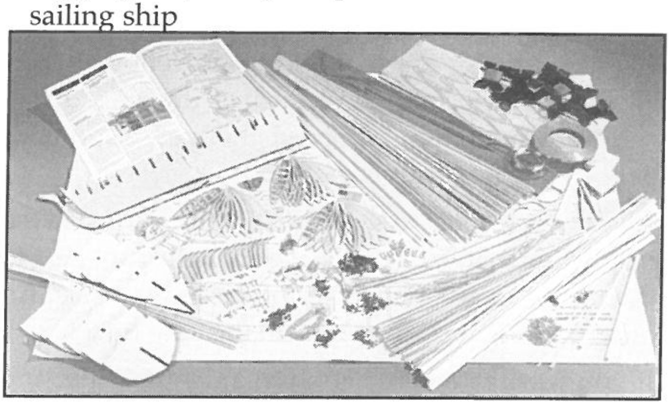


FIG. 1-1 -
CHARLES MORGAN KIT COMPONENTS
PHOTO BY MODEL SHIPWAYS, INC.

Figure 1-1 shows the contents of Model Shipways' *Charles W. Morgan* kit. Some U.S. kit manufacturers and most foreign ones use more elaborate packaging. Figure 1-2 illustrates how the Italian manufacturer Mantua-PanArt ships the fittings for *Royal Caroline*, a 1749 British royal family yacht.

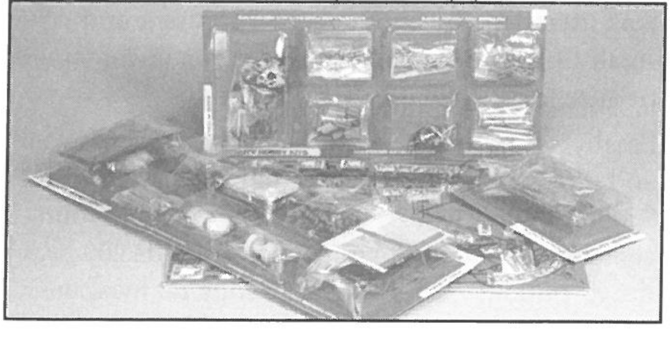


FIG. 1-2 - KIT FITTINGS PACKAGES

Upon opening a kit, sort the parts into the above-mentioned categories. Check each item against the parts list and for imperfections. Make sure the wood is straight and dowels haven't warped due to changes in temperature and humidity. If a fitting is absent or damaged, don't hesitate to write or call the manufacturer. Most, including Model Shipways, will replace missing pieces. If the manufacturer won't exchange a damaged part, discard it. Warped wood defeats our objective of producing a first-rate kit model.

Just because a part is on the parts list is no guarantee the correct quantity is included. If the plans call for 40 deadeyes and the kit supplies 20, you have a legitimate gripe. The same applies to items such as eyebolts, chain, belaying pins, and rigging line.

PLANS VERSUS PARTS PROVIDED

You essentially get what you pay for. While the kit provides numerous fittings (belaying pins, chain, blocks, deadeyes, etc.), not every item is prefabricated. Die- or laser-cut wooden parts may be provided for only difficult-to-make items such as bulkheads, knees on fife rails, or the stem. Laser-cut parts are excellent, but add to a kit's cost, so the number included varies. Most deck fittings are metal castings, especially if scratch building them requires a metal-turning lathe or other elaborate equipment. Some manufacturers supply cast mast bands, while others provide brass strip from which to make them. With the introduction of laser cutting, wood has replaced many white metal or britannia fittings.

PLANS AND INSTRUCTIONS

Often the biggest stumbling block to producing a first-rate model are the plans and kit instructions. The first question is historical accuracy. Do the plans correctly portray the named vessel? This is a hairy question. The designer may or may not have consulted accepted references. Often, he or she makes difficult decisions when reconstructing the plans. For your model to reflect the best possible representation of a particular ship, you must engage in a little research. Look for other plans of your ship in maritime museums, books, and magazines (see Appendix A). Contact knowledgeable modelers or historians via the Internet. Those participating in discussions are open to your queries. If you're not on-line, book time on a computer at your local library or join a modeling club.

Let's assume the plans are properly researched. The next question is how well are they prepared? Do they and the instructions provide sufficient information for you to complete the project? The quality of plans and instructions vary from excellent to plain lousy. Many foreign kit instructions are literally translated and make no sense. Some areas where additional information may be required or a problem exist are:

1) If this is a laser- or die-cut plank-on-bulkhead hull, do the plans and/or instructions show how to plank it?
2) Is there a planking layout? If not, follow the guidelines in this book. Even so, you may still need a monograph on hull planking to accurately develop the strakes.
3) If this is a solid hull model, do the plans contain a lines drawing through the hull or templates for carving it? Most machine-carved solid hulls don't precisely meet the hull lines.
4) Are there enough views of the various deck structures to accurately construct them? If given only a plan view and profile, how do you know what the fore and aft ends look like? Is there a port hole or other detail on the ends? This question is a curse, for no historical evidence may exist to answer it.
5) Are head rails on sailing ships illustrated in plan and section views? If not, photos of models or actual ships may clarify these difficult areas. Likewise, transoms have unusual curves and structures that must be defined before starting to build.
6) Do the plans show how the anchor is stowed and the cathead rigging?
7) If the ship has small boats, are their internal structure and gear illustrated?
8) Are the rudder's pintles and gudgeons illustrated or the hinges on gunports?
9) Are mast bands and caps, yard trusses, studding sail boom fittings, and yard parrels drawn in detail? Quality models must include these important elements.
10) Check the drawings of masts and spars. Yards on older sailing ships were eight-sided at their centers, and masts were similar shaped at their heads and heels. Are these octagonal sections shown, or is the spar one round dowel?
11) Are mast tops, trestletrees, and cross-trees adequately detailed? Consult Appendix A if your plans are inadequate.
12) Are rigging lines and block sizes dimensioned on the plan? Are there details of how blocks are stropped, how lanyards rove through deadeyes, or in what order chain plates are assembled? Do the plans show how to rig the futtock shrouds or connect halliards to yards, jeers, trusses, and slings? I'll discuss these and other details later.

SETTING UP YOUR WORK AREA

Whether you own an elaborate workshop or not, sufficient light is critical. Supplement overall lighting with a high-intensity lamp on the worktable. General overhead lighting provides approximately 25-foot-candles of light at work level. However, 100 foot candles are required to prevent eyestrain when doing close-up work such as drafting, drawing, and modeling. I learned this years ago and, believe me, it is correct.

Allow ample room to spread out parts, plans, and the instruction manual. Also, leave enough space next to the model to accommodate the necessary tools. An orderly work area saves time in the long run.

If you work in a basement, run a dehumidifier and oscillating fan during the summer and a space heater in the winter. They add to your comfort. If you're like me, turn on a radio or tape player and enjoy soothing music while you work.

Sort all wood by thickness. After selecting and cutting what is needed, return the remaining stock to its proper pile. Most kits come with enough wood, so don't worry about using a piece for one item that was intended for another. Sort castings and other small fittings into plastic boxes or small containers. Be sure these have lids to keep out dirt.

Finally, working on a model creates a big mess. Paint and glue spill, so keep rags handy. A great product, Scott's Rags-in-a-Box, is available at do-it-yourself centers like Home Depot. Each box holds 200 heavy duty, pullout paper towels. They're inexpensive when compared to cloth shop rags. I keep two boxes in my workshop, one in my art/drafting room, and one outside in my garden shed.

CHAPTER 2
TOOLS AND THE BASICS

The following items are recommended for building any model.

- Hobby knife with #11 blades. Also single-edge razor blades (blade is thin and sharp enough to cut smoothly across wood grain).
- Fine-tooth razor saw or a jeweler's saw with assorted blades.
- Four-inch-long standard or diamond needle files for finishing cast metal fittings and smoothing wooden parts. These are extremely useful.
- Pin vise and set of #60 to #80 miniature bits. Though more expensive, high-speed steel bits are better than carbon ones, especially if drilling brass.
- Wire cutters, tack hammer, small center punch, self-closing and regular tweezers, small pointed scissors, round- and flat-nose miniature pliers, and small bench vise.
- Micro reamers to clean out holes in blocks or enlarge other ones.
- Small C-clamps, wooden clothespins, and assorted sizes of rubber bands.
- Set of gouges and chisels for assorted carving tasks.
- Arkansas or diamond honing stone and leather strop. Quality work demands sharp tools.
- Dial caliper for measuring wood and wire diameters. Although more expensive than a vernier caliper, it's easier to read and more accurate. A digital caliper is the top of the line and the most expensive.
- Soldering iron or torch, solder, and flux. Pencil micro torches (burn butane) are ideal. They're easy to fill and use.
- Architect and metric scales. A triangular architect scale will have most of the required kit scales. A center finder ruler is also helpful.
- Small machinist's square and protractor, or adjustable square to measure angles.
- Cheap tools - Round toothpicks have numerous applications. Stick one in a block to hold it while painting. Microbrushes (trade name) are bendable toothpicks with a fuzzy end. Use them to apply a controlled amount of glue. Women's hair clips make excellent lightweight clamps. Cotton swabs are good dusters and cleaners. Aluminum push pins hold parts. Don't buy those with plastic heads. They shatter.
- Sprue cutter to remove plastic fittings from their part's tree.

The above tools are generally found in most model catalogs. However, don't overlook other sources. Some surgical instruments are ideal for modeling, as are dental picks and scalers. Self-locking hemostats have ultra fine serrated edges that hold small parts firmly without losing their grip. Check the fisherman's fly tying industry for rigging tools. The point is, expand your horizons.

Tools are a matter of choice and financial wherewithal. Power tools are more expensive, but make the work easier and sometimes more accurate.

Band Saws

Delta's or Ryobi's 8-inch band saw runs quietly and accurately. They handle 1/8-inch blades, which makes them ideal for model work. Reasonably priced. I couldn't live without mine. If you can afford only one power tool, this is it.

Lathes and Milling Machines

Sherline: Expensive, but an excellent, accurate metal lathe. Milling machine is sold as an attachment or separately.

Taig: High quality metal lathe and milling machines. Not as expensive as Sherline's, but that's because it doesn't have all the milling attachments for the lathe.

Unimat 1: Wood and metal lathe, milling machine, drill press, jig saw, and sander rolled into one. Quality and price are middle of the line. A good unit for the money.

Carba-Tec, Klein, NOVA, Comet, and Vicmarc: Small wood-turning lathes. Carba-Tec has a variable speed motor and is a good companion to the Sherline metal lathe. Both have identical threaded heads and morse tapers, so accessories are interchangeable. Klein, NOVA, Vicmarc, and Comet are more expensive, but their quality is higher.

Drill Presses

Preac: Top of the line. Expensive, but made especially for model makers. Accessories include an X-Y table and rotary table.

Delta, Sears Craftsman, Grizzly: Small bench units. Larger than Preac's. Excellent quality at a reasonable price. Use a handpiece or machinist's pin vise in the larger chuck to hold hobby bits.

Table and Scroll Saws

Preac: Top-of-the-line table saw. It's expensive, but worth every cent.

Dremel, MicroLux: Scroll saws. Good quality, reasonably price. MicroLux's holds standard jeweler's saw blades for fine work.

Handpieces and Detailers

Foredom, Pfingst: Top-of-the-line flexible shaft handpieces. Excellent quality. Great for carving hulls or performing a multitude of modeling tasks.

Dremel: Full line of rotary tools for drilling and carving. Many accessories.

SDM, NSK, Gesswein, Ram, Optima: High-speed detailers. A flexible wire connects these pencil-like tools to their control boxes. Motor is in the handpiece. Has a rapid-action collet. Multi-speed, reversible electric unit reaches 35,000 RPM. Size and reversibility make it more useful than Dremel's flexshaft. Drill and carve using numerous accessories. Bird and gunstock carvers like these expensive units, but they're also finding their way into the professional modelmaker's realm.

Turbo-Carver: 400,000 RPM air-powered handpiece works off bottled CO2 or a 1/4-HP air compressor with storage tank. Comparable to a dentist's drill, but costs only one-quarter as much. Feather-light strokes remove astonishing amounts of material while the operator maintains tremendous control over the cutting action. Also works better than any fret saw.

Power Carvers

Ryobi: Inexpensive power carver looks like Dremel's flexshaft. Two speeds, reciprocating, up to 10,000 strokes per minute. Comes with several chisels.

Thickness Sanders

Preac: Top-of-the-line unit with motor. Expensive, but worth it.

Royal Products: Power source is an electric drill (not supplied). Not as expensive as Preac's.

Airbrushes

Badger, Binks, Testors, Thayer and Chandler, Paasche, Revell-Monogram: Airbrushes are essential for a great paint job. They require either an air compressor or the less expensive cans of propellant. All are quality brushes; not too expensive. The real expense is adding a spray booth. More on this later.

Additional Supplies

Besides tools, you'll need supplies generally not included in a kit such as:

- Adhesives, wood filler, and paint.
- Beeswax for treating rigging line.
- Cotton, nylon, polyester, silk, or linen thread for seizing rigging (sometimes included in the kit).
- Sailcloth for sails (sometimes included).
- Brass and britannia blackening solutions, and another chemical to weather copper if the hull is sheathed.
- Plastic Prep or liquid dishwashing detergent to clean the surface of plastic parts before painting.
- Quality sandpaper such as garnet, aluminum oxide, or silicon carbide in 100, 150, 220, and 400 grits. Wet-or-dry 400-grit paper has a waterproof backing and is ideal for polishing metal.
- Dry transfer lettering, decals, or plain decal paper for the ship's name. I will discuss this later.
- Magnifying glasses. A low, one or two power for general viewing, and a 10 power for close-up investigating.
- Roll of calculator or cash register tape for ticking off dimensions from the plans. Buy a 120-foot roll of 1-1/2" (38mm) wide tape at any office discount store. It's cheap.

Maintaining and Using Tools

Buying tools is an investment. Top-of-the-line equipment lasts a lifetime, gives superior service, and produces accurate results. The extra money spent on the initial purchase is far less than replacing inferior tools because they don't have enough power, are too small to do the job, can't maintain close tolerances, or wear out. However, if you don't know how to take care of tools and use them effectively, then you've wasted your money.

Cutting tools such as hobby knives or carving gouges and chisels are basic to ship modeling. They work well if kept razor sharp. The common #11 hobby blade, developed by X-Acto, doesn't stay sharp for long and the tip breaks easily. These blades can be sharpened on a standard grindstone or "sharpening saddle" (sold by Eastern Tool & Supply), but holding an edge is still difficult. Hobby blades are inexpensive if purchased in packs of 100. My solution: when one becomes dull, chuck it and grab a new blade.

Excel and Pro-Edge manufacture a superior #11 blade. It's stiffer and holds an edge longer than X-Acto's, because the blade is 0.002″ thicker. It's also sharper, because the edge is double honed. Testor repackages and sells Excel blades under the Model Master name.

Gouges and chisels are too expensive to toss when dull, so sharpening is the way to go. A fine Arkansas or diamond stone will keep them razor sharp the way they should be. Don't become impatient and quit before a tool is sharp. Hone the blade and use a leather strop to remove the burrs sharpening raises. This makes the edge last longer. To test the edge, slice a piece of 1/32″ thick basswood. Cut at a 45° angle while slowly moving the blade from one side to the other. If it grabs in a certain spot, chances are it is still dull. Hone and strop again until you can slice cleanly with all areas of the edge. When woodcarving, as soon as you feel the tool grab, stop and go back to the honing bench. Your cutting tools should slice through wood like a laser through ice cream. Forget to maintain your tools and the results will show up in your work.

The airbrush is a grand tool for painting, but it frustrates many modelers. The basic problem is they don't keep it clean, especially when using fast-drying acrylics. An airbrush has paint and air passages, and some holes. These clog quickly, but proper maintenance is just as fast. After every painting session, spray thinner through the airbrush to clean the passages. Periodically disassemble the airbrush and clean out the passages. Watch the tip. Paint collects here and prevents proper atomization. Clean it with a #11 hobby blade and thinner.

A paintbrush also can clog easily. Most often paint builds up near the ferrule, so frequently douse the brush in thinner. Also, just dip the tip of the brush into the paint; don't shove it in over the ferrule.

Lathes can be frustrating if not properly adjusted. Spend some time making sure everything is aligned before using it. Even so, you'll probably discover small parts like belaying pins don't turn true. This happens when you use stock slightly larger in diameter than the fitting. Doing so produces too much wobble. Therefore, use stock that is oversize, true it first, then turn the part.

When setting a rip fence on a table saw, don't depend on the locking handle to position the fence an equal distance from the blade. Chances are, it won't. A fence not parallel to the blade produces binding and burning. Always determine the blade line with a straightedge, then measure from both ends to set the fence.

A band saw's blade runs in a large hole. For model work, the hole must go or small parts will, too. Cover the hole with a smooth, flat, hardwood board or, better yet, one covered with plastic laminate. (A sheet of 1/4″ thick plexiglass also works well). Saw a slot to the center of the board using the band saw. Then, reverse the board so the slot is behind the blade. Screw or clamp the board to the saw's table. When cutting extremely small parts, fit a sliver of wood into the slot behind the blade as an added precaution against losing them.

Another recommended band saw modification is substituting the saw's steel guide blocks with low friction ones. Set these tightly against the blade to keep it running true.

Those without power tools must rely on hand tools. Use a single-edge razor blade for cutting small wooden strips on the cross grain. The razor blade is thinner than a #11 hobby blade, which adequately performs most other cutting jobs. Jeweler's saw blades are fragile and snap easily. To reduce breakage, insert the blade backward into the frame. Now it cuts when you pull rather than push. Support the wood you're cutting in a v-slot clamped to your bench. Either buy the v-slot or make this from wood.

Razor saws work more efficiently in a small miter box. Buy an aluminum one or make your own from hardwood.

WOOD IN SHIP MODEL KITS

Model Shipways occasionally substitutes lime (*Tilia vulgaris*), a European wood, for basswood (*Tilia americana*) in its kits. Both have a fine, uniform texture and straight grain. Lime, however, has superior steam-bending qualities. It is often called basswood in Europe. While basswood is common in U.S. kits, manufacturers occasionally include walnut and cherry. Foreign kits tend to use more exotic hardwoods.

Most modeling wood comes in 1/32″, 3/64″, 1/16″, 3/32″, 1/8″, 5/32″, 3/16″, 1/4″, and 1/2″ thick sheets and strips. Strip widths are in the same increments, while sheets may be 1″, 2″, 3″, or 4″ wide. Depending where the wood was purchased, measurements are given in either Imperial or metric, even in U.S. kits. Model Expo buys a lot of wood from Europe, so expect to see a 1mm instead of a 3/64″ strip. The difference is not more than one hundredth of an inch, but check with a scale or caliper to know exactly what you have.

Wood strips or sheets can generally be used as is. However, a strip must occasionally be thinner than the supplied size (especially true for 1/64" or 0.4mm thickness). To maintain scale, sand the strip to the required thickness with a sanding block before making the part. Another way to reduce stock is with a commercial thickness sander. Or, chuck a sanding drum into your drill press, then clamp a block alongside the drum to act as a fence. This makeshift tool works quite well.

Some experienced modelers prefer hardwoods such as cherry, boxwood, pearwood, maple, and applewood to basswood. The harder woods don't fuzz up and finishes are easier to apply. Nevertheless, bass is still an excellent modeling medium. Its basic problem is edges. They're easy to sand round when they should be sharp, and they are readily damaged. So, be cautious, sand smoothly, and rely on primers to subdue the fuzz. (See the section on sanding, wood filling, and priming in this chapter.)

CAST METAL FITTINGS

Britannia metal fittings have replaced white metal ones in most wooden ship kits. White metal contains lead and, for whatever reason, castings disintegrated. (A fitting has a high lead content if it has a dark gray color and cuts easily with a knife.) One solution is to double prime the part before painting it, thereby sealing its surface and increasing longevity. The other answer is to discard it. Britannia is a tin, copper, and antimony alloy. Some manufacturers add lead to the mix, but the percentage is minute and no one has reported evidence of corrosion.

Metal castings require final finishing before mounting on the model. First, remove mold joint flash with a #11 hobby blade, then file or sand with fine sandpaper. Second, clean parts in dishwashing liquid and warm water to remove traces of mold release agent and the body oils your fingers deposit. Rinse thoroughly and allow to dry completely before applying primer and paint.

WORKING WITH BRASS AND COPPER

Again, I'll discuss specifics later; meanwhile, here are some guidelines:

Cut brass or copper sheets and strips with a small pair of tin snips or heavy scissors. Thicker metal will require a jeweler's saw. After cutting, smooth the edges with needle files followed by wet-or-dry fine sandpaper used dry. Cutting slivers from brass or copper sheet curls and bends it sideways. To straighten, grip the ends with a pair of small pliers and pull in opposite directions. Thin brass or copper sheets can be scored with a utility knife and metal straightedge, then snapped off. Use two or three light passes, cutting against a maple chopping block, birch board, or glass.

Drilling holes in brass with a pin vise is a slow process. While copper isn't quite as difficult, the solution is to use a handpiece or drill press. Back the metal with a 1/4" or thicker piece of maple or birch. (Avoid softwoods, as these flare the exit hole.) To prevent the bit from wandering, mark the spot with a small center punch. Lubricate the bit with light oil and drill slowly to avoid breakage. The brass will become hot, so clamp the pieces to the drill press table or hold them down with a wooden stick. Do not touch the brass! If possible, keep the speed below 2000 RPM. Anything higher will generate enough heat to break small drill bits.

SOLDERING

Until recently, modelers used pure silver solder to avoid the corrosive qualities of lead in soft solder. Today, many solders are lead free, composed of tin and antimony or tin and 3% to 4% silver. They are strong and melt at about 430°F (211°C). Consequently, no reason exists to use pure silver solder (melts at 1300°F or 704°C). Tix (trade name) solder melts at 275°F (135° C). It is excellent for applications where limited heat is needed. I believe Tix is lead free and contains only bismuth and tin. Formulas with some lead usually melt at less than 200°F (93°C).

The key to soldering is keeping the metal clean. Use a solvent, sand lightly, or both. Vinegar is a good brass cleaner. Just slosh it on and rinse with water. Or, purchase cleaners made especially for soldering at any electronics store such as Radio Shack. Once the parts are clean, don't touch them. Your fingers will leave greasy spots. Soldering is easy if your work is set up properly. First, immobilize the parts in a fixture or other holding device. If using a soldering iron, plug in the iron and wait until it is hot, usually about one minute. An iron is ready when solder touched to its tip melts. Now clean the tip by melting some solder on it, then dragging the top across a sponge moistened with water. A tip thinner also works well. The idea is to always have a bright, shiny, clean tip. Clean it every time you solder. If an iron sits for more than a minute, the tip is no longer clean.

Add just enough rosin or acid paste flux to the joint to do the job. Although rosin core solder is effective, using solid solder and a separate flux allows you to control its application. Solder flows where flux is applied.

Next, cut a small piece of solder and lay it on the joint. If all components are hot enough, the solder will flow when heat is applied from iron or torch. Use only as much solder as necessary to provide adequate coverage and a solid bond. In most circumstances, only four to five seconds are needed to complete the process. While needle files will remove excess solder, it's better to use a desoldering syphon or desoldering braid. Either one easily and cleanly draws up molten solder before it hardens. The joint should look like the real thing, not a big glob of fillets.

Now clean the area with flux remover. A properly soldered joint is clean, shinny, and smooth. Anything else is known as a cold solder joint. Dull, lusterless balls of solder with dark flux residue are an indication of inadequate heat, dirty equipment, or inferior products being used. When soldering, run a small muffin-tip fan to ventilate your work area and wear safety glasses.

ADHESIVES

White (polyvinyl acetate or PVA) or woodworker's glue (aliphatic resin) in yellow or tan will suffice for most modeling jobs. White glue is used on seizings because it dries transparent. Five-minute epoxy provides extra strength for affixing fittings. Cyanoacrylates such as Jet, Flash, Hot Stuff, Pacer, or Zap produce quick adhesion. (Super Glue is a registered trademark, but the term is applied erroneously to any adhesive that bonds in about 15 seconds.) Medium viscosity, gap-filling varieties work best for most gluing jobs. However, use the ultra-thin, watery type for filling a narrow crack or tacking hull planking to bulkheads. Accelerators or "kickers" harden cyanos instantly. The accelerator is usually sprayed on one part and cyano applied to a second fitting. When joined, the two pieces bond immediately.

A word of caution. Cyanoacrylates are mean. They react so fast, you can easily glue your fingers together or to the workbench where a little was spilled. Don't ever rub your eyes. You wouldn't be the first to bond a finger or hand to an eyelid or socket. Should you glue your fingers together, the first rule is don't panic. You will have purchased a large container of debonder when you bought your first bottle of cyano. Simply soak your joined digits in the solvent and the cyano will gradually loosen.

By far the best adhesive (not really an adhesive) for plastic models is liquid solvent. It enters seams via capillary action, softens the plastic which bonds to itself. Snap the pieces together, then touch the joints with a brush dipped in the solvent. The job takes only a few seconds.

As mentioned earlier, Microbrushes are excellent for applying adhesives, especially cyanos, because they don't drip. A metal applicator with a small, bent end to hold glue is also available. Beyond these, a round toothpick is as good an applicator as any.

WOOD FILLER

Basswood often needs a little lightweight wood filler rubbed here and there. Fillers intended for most hardwoods, such as Famowood, Duratite, or Elmer's, are too hard. Basswood will sand away before these fillers do. Any hardware store vinyl spackling compound is your best bet. DAP is one brand. In recent years, an ultra-lightweight spackle has appeared on most hardware store shelves. Model Expo sells one called Model Magic. Regular spackle is used directly from the container, but Model Magic must be stirred to homogenize the micro balloons. After testing, I think the regular spackle is the best and easiest to use.

Apply spackle with a small chisel or wooden stick shaped like one. If the defect is large, apply two coats and wait until the first one is dry before adding the second. If the spackle shrinks a bit (which Model Magic doesn't), add more filler.

Caution: Spackle is a plaster-like substance. After applying it, don't wash off the residue with a wet rag or you'll remove the filler as well. Just sand it.

SANDING, WOOD FILLING, AND PRIMING

The finish on a first-rate model is critical, and a super paint job requires a good foundation.

Hobby paint gray primer or any auto body gray primer will highlight scratches and other defects. White primer is all right, but doesn't show up the imperfections as well. Prime all metal fittings and woodwork to be painted, but not those parts slated for staining or varnishing.

Begin sanding wooden parts with 100 or 150 grit and work up to 220 grit paper. For metal castings, use 400 grit wet-or-dry paper. Before priming, wipe off every speck of dust, then give untreated surfaces two light coats. Sand lightly after the last application. Don't sand down to bare wood. After washing your hands, gently dust the hull or parts with a soft brush and clean, soft cloth or tack rag. Now look for scratches and dents. To detect them, hold the hull or parts to a light and view from different angles. Fill any blemishes with a spackling compound. Use the filler sparingly to avoid creating a huge sanding job. After smoothing the spackled areas, prime again and reinspect. Continue filling and priming until the defects are gone. Don't become impatient. The job may required a dozen or so reprimings before it's completed. Correcting a flaw after painting begins is not the way to go.

Painting Walnut and Similar Hardwoods: Kits with double-planked hulls usually contain walnut for the outer layer. However, its grain is too open and coarse for the scale of most models. If the hull requires paint, fill the grain with a paste filler, wood filler or spackle before priming. Unlike basswood, walnut's deep grain shows up under model paints, especially if applied by airbrush.

PAINTING

Much time and effort are saved and more professional results obtained if the finishing process is carried out during construction. Proper timing when applying finishes and using masking tape to define painted edges should eliminate unsightly glue marks and splotchy stained surfaces.

Paint Schemes

Either the kit plans or the instructions will probably contain the model's color scheme. If they don't, or the description is incomplete, do some research to determine the proper scheme before starting to paint.

Paint

Model Shipways, Testor, Tamiya, and Humbrol manufacture quality hobby paints. All contain ultra-fine pigments ground exclusively for use on models. Model Shipways and Humbrol also have premixed marine paints in typical ship colors. Acrylic and solvent-base paints are available in flat or gloss. Jo Sonja artists' paints (used by bird carvers) or Holbein Acryla Gouache are also acceptable. They are a combination acrylic-gouache and dry dead flat. Ship models look best in a flat finish, because details show up better. Sometimes the required color comes only in gloss. To subdue the shine, spray on a clear, flat finish from the manufacturer's product line. Don't mix brands. When airbrushing, always use the manufacturer's recommended thinner.

Stains and Finishes

Stain wood with Hobby paint stains, Minwax, or other brand. After staining, protect the natural finish with a low sheen polyurethane varnish or resin like Minwax. Any clear hobby finish works, too.

Many foreign and some U.S. kits supply exotic hardwoods or walnut so the hulls can be finished with oil or varnish. Natural finished models are popular in Europe. For the modeler who elects not to paint the hull, I recommend applying tung or Danish oil. Polyurethane satin varnish also is acceptable.

Brushes and Procedures

Purchase quality, soft sable or synthetic hair artist's brushes. Small pointed ones are good for details; #10/0 for extremely fine work, and #0 or #1 for general painting. Use a 1/4" to 1/2" wide flat brush on the hull, and a 3/32" wide flat brush for smaller areas like a hatch or cabin.

Before painting, clean the model with a tack rag. Thin paint to a consistency that eliminates brush strokes, but doesn't run. Apply in smooth, even, overlapping strokes. Light colors will cover the primer in four or five coats, and dark colors in maybe two. Check the finish between applications, and sand or add spackle to eliminate blemishes.

Use masking tape wherever two colors meet. While several brands are made especially for model work, electrician's black plastic tape is ideal. It leaves a crisp edge and isn't overly sticky. Do not use drafting tape. Its edge is wrinkled and paint may run underneath. Office and art supply stores sell Scotch Magic Plus removable transparent tape. It, too, is excellent for masking, removes easily, and doesn't chip off paint when peeled. However, don't reuse it, for it doesn't adhere well the second time around. Chart tape is also a good masking tape and comes in very narrow widths.

Airbrushing

Airbrushing solvent-based paints is easy, but the fumes are toxic. Spray only in a ventilated booth or do it outdoors. Those with a workshop can build a spray booth. Assemble a four-sided wooden box 3 feet wide by 2 feet high by 2 feet deep. At the back, install a 250-cubic-feet-per-minute squirrel cage exhaust blower and a 6-inch diameter stove pipe to vent the fumes out a window or hole in the wall. Caution: Do not use a 4-inch pipe. It may not handle the airflow and result in back pressure. Check the specifications on the blower for the required exhaust pipe size. Install a furnace filter over the blower opening to prevent paint from fouling the blower blades. Mount a 2-foot long fluorescent light at the front of the box. While this setup takes a little space, it can always be used for hand painting or just modeling.

While acrylics are not toxic, they are difficult to airbrush. Always use the recommended thinner or alcohol. Thinning with water causes surface tension problems. Even when the recommended thinner is employed, acrylics do not cover as well as solvent-based paints, are spitty, and often clog the airbrush. However, the tips on Testor's Aztek airbrushes are designed to handle acrylics. They spray better and clean easier than other brands. Experiment on your own. Some modelers are successful spraying acrylics; others have poor results (like me).

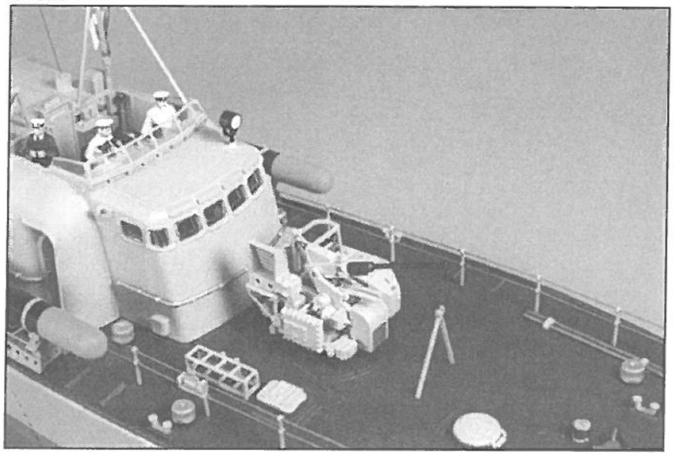


FIG. 2-1 - VOSPER PT BOAT

An airbrush is essential for painting plastic and modern kit models due to their intricate detail. Figure 2-1 shows one of my plastic models, Tamiya's Vosper PT boat. Notice the elaborate detail, especially the guns. Painting them with a brush would have been difficult and the result not as satisfactory. These ships have a lot of metalwork with sharp edges, so blemish-free painting is essential if they are to look authentic.

CHAPTER 3
BUILDING THE HULL

Wooden ship model kits come in three types of hull construction. The first is a solid, machine-carved hull. While most modelers don't plank it, some do for its realistic effect. Second is plank-on-bulkhead. Here, a series of bulkheads fit into a center keel piece, then individual planks are attached over them. Number three, plank-on-frame, is rare and simulates how real ships were built with frames set upon a keel.

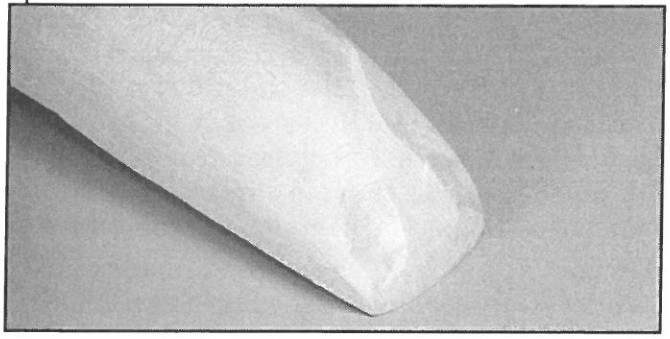


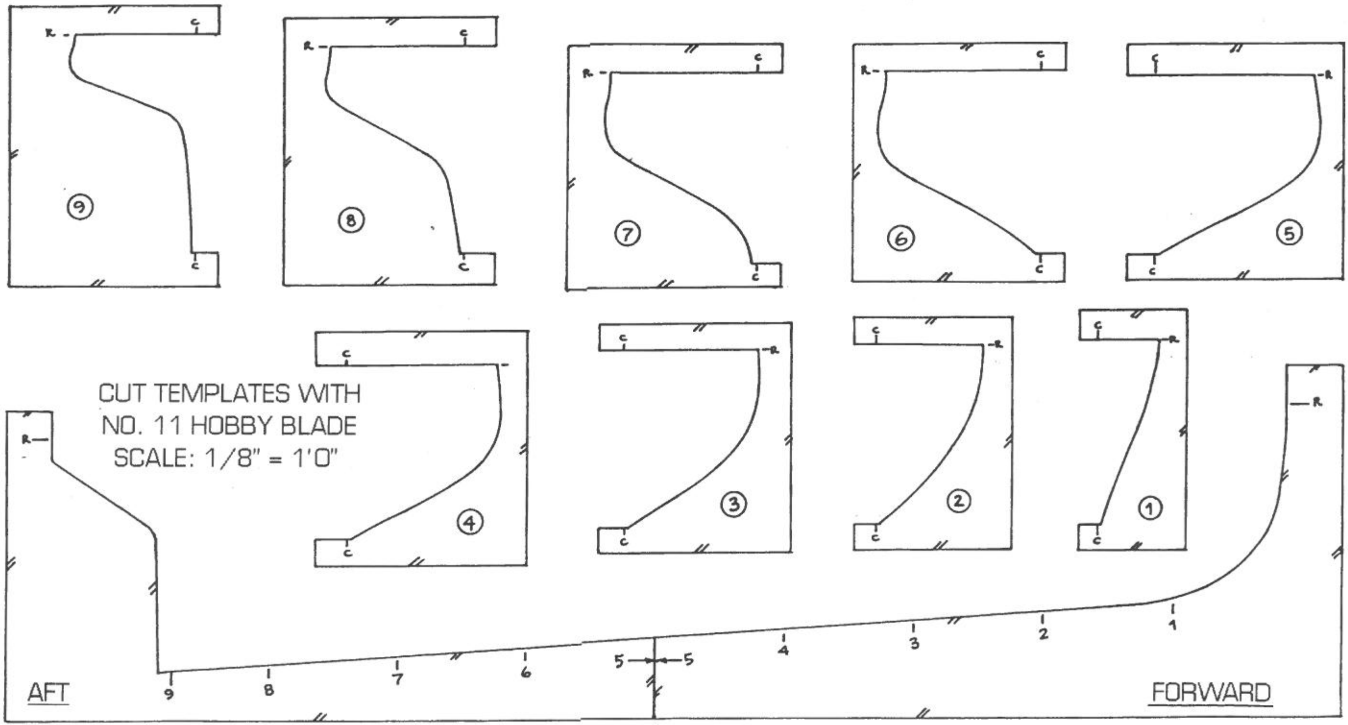
FIG. 3-1 - SULTANA - MACHINE CARVED HULL STERN DETAIL

SOLID WOOD HULLS

Sometimes the ad reads, "Only light sanding required." Well, this is true if you're satisfied with a shape anyone can recognize as a ship's hull. However, it doesn't accurately reflect the named vessel's hull lines. That requires carving. Figure 3-1 shows the stern of Model Shipways' solid *Sultana* hull. Carving it to the correct shape is not difficult if you take your time. After all, the machine has already removed most of the stock and done the complicated cutting.

Most kits provide a body plan; that is, a series of sections (stations) through the hull. Builders use these lines to make their own templates for carving the hull. Some kits, however, such as Model Shipways' *Phantom, Sultana,* and *Elsie,* supply card-stock templates (Figure 3-2). The plans should also have a set of waterlines and profile with buttock lines. These tell where to position the templates on the keel. (The naval architect created the overall hull from these lines.)

Most kit plans are drawn to the *outside of the planks.* Look for this in a solid hull model. However, if a drawing is labeled *to inside of planks* or *outside of frames,* then add a plank's thickness to the body plan measurements. Although rare, it does happen. One



CUT TEMPLATES WITH NO. 11 HOBBY BLADE
SCALE: 1/8" = 1'0"

B. LANKFORD '95

CUT HERE

PHANTOM HULL TEMPLATES
©MODEL SHIPWAYS, INC. 1995

FIG. 3-2 - PHANTOM HULL TEMPLATES

example is Model Shipways' *Sultana*, developed by Howard Chapelle who worked from original drafts. If the plans aren't labeled to what side of the plank or frame they're drawn, look at where the hull intersects the keel. Is there a rabbet at the keel and are station lines on top of it (Figure 3-3)? If yes, the plans are drawn to the inside of the planks.

To make templates for an unplanked solid hull with plans labeled *outside of planks*, lay tracing paper over the body plan. Trace one station at a time, then transfer it to heavy stock (file folders work well) using carbon paper. Mark the centerline at the keel and deck level. After copying all the templates, cut them out with a #11 hobby blade. Don't use scissors, as a crisp edge is vital. If the plan is labeled inside of planks or outside of frames, add a plank thickness to the station lines. For planking a solid hull with plans labeled to outside of planks, redraw the templates by subtracting a planks thickness so the finished hull matches its hull lines (Figure 3-4).

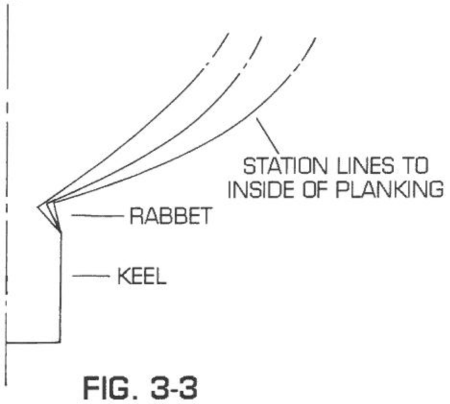


FIG. 3-3
HULL LINES TO INSIDE OF PLANKING

Shaping the Hull

Sanding will shape part of the hull, but a little carving is also required, especially at the rail, keel, bow, and stern. Take particular care to maintain the stern's symmetry above the rudder. Because a hull mustn't wobble during carving, clamp it in a vise mounted to an unmovable structure. To prevent the jaws from marring the wood, make a "handle." Cut a block of scrap wood narrower and shorter than the deck and at least 2" (51mm) deep. Screw this to the deck, then clamp the handle in a bench vise.

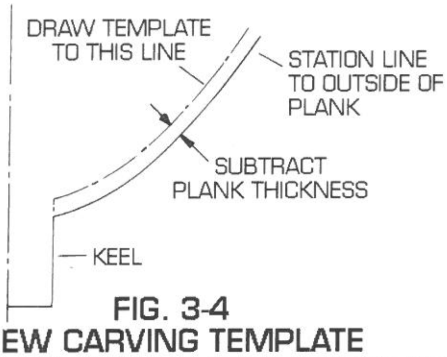


FIG. 3-4
NEW CARVING TEMPLATE
TO ACCOUNT FOR PLANK THICKNESS

Mark the centerline, rabbet lines (where hull meets keel), and station lines in pencil on the model. Place the station marks on the bottom of the hull and on top of the rail, so they won't be removed as you carve. With chisels and gouges, start at amidships (maximum beam) and progress forward, then aft. Avoid carving against the grain by moving forward or aft until you find a spot going *with* the grain. For most of the hull, a flat chisel will suffice. For concave surfaces near the stern, a gouge with a generous radius will be required. You can also use a diamond or other cutter in a rotary power tool to remove wood quickly, then smooth with a chisel or gouge.

Work slowly, carving away a little stock at a time. Templates rarely fit well at first, so try them often, being sure to hold them perpendicular to the keel. Compare each template to its hull station, then visually decide where to remove more wood. Recheck the templates. When they fit well, switch to sandpaper to obtain the final shape. Smooth the transom with a sanding block. Sanding blocks are handy to have. Make up several sizes of sanding blocks from scrap basswood, gluing the paper (various grits) to the block. The block prevents the sandpaper from gouging the wood which could happen if done by hand as your finger presses in a given point. Sanding blocks can be quickly made if you purchase sandpaper with a sticky backing. These are generally found as paper for rotary sanders. Figure 3-5 illustrates how to use templates and where to remove excess stock.

Finally, draw a few horizontal pencil lines (like waterlines) and the station lines on the hull. Use these to visually check its shape. Hold the hull at various angles and sight down it to see if the pencil lines are fair (even). This usually reveals any dips or bumps. One way to double check your eyes is to lay a 1/8" (3mm) square wooden batten along the hull at various locations. Depressions will show up beneath it.

Waists and Wales

Some ships had thicker hull planking below the waist, producing a "step" in the hull. If your model has one, prepare the templates to include it and

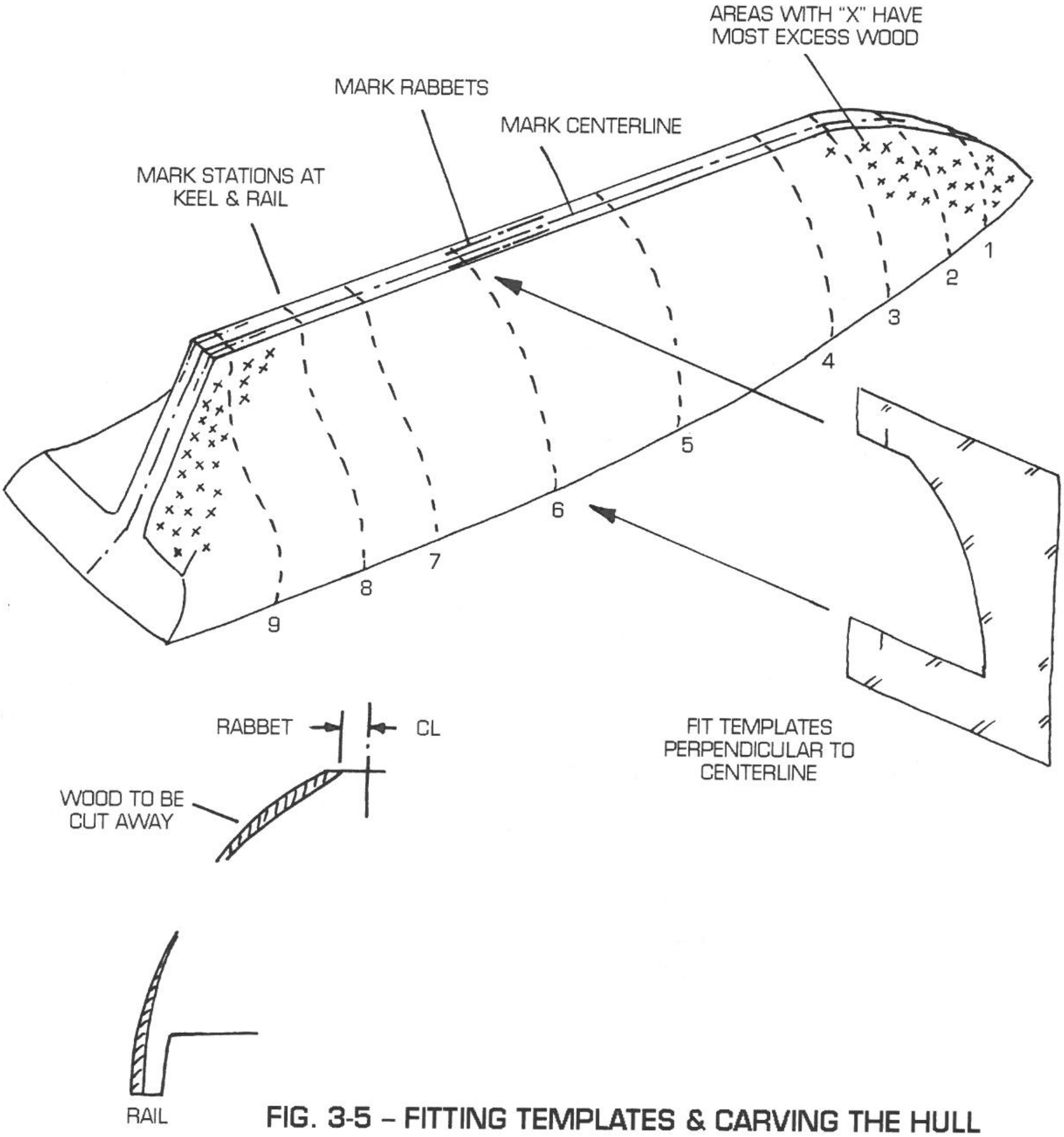

AREAS WITH "X" HAVE MOST EXCESS WOOD
MARK RABBETS
MARK CENTERLINE
MARK STATIONS AT KEEL & RAIL
1
2
3
4
5
6
7
8
9
RABBET
CL
WOOD TO BE CUT AWAY
FIT TEMPLATES PERPENDICULAR TO CENTERLINE
RAIL

FIG. 3-5 – FITTING TEMPLATES & CARVING THE HULL

carve the step. Other vessels had a pronounced wale strake. Planking here was thicker than it was above and below the wale. A hull could have more than one step depending upon its design. It's possible to carve these heavy strakes as part of the hull if the pre-carved block has sufficient width. If not, glue separate wooden strips of the appropriate thickness to the wales (Figure 3-6). Variances in plank thickness are important to the hull's overall accuracy. Don't become lazy and omit them.

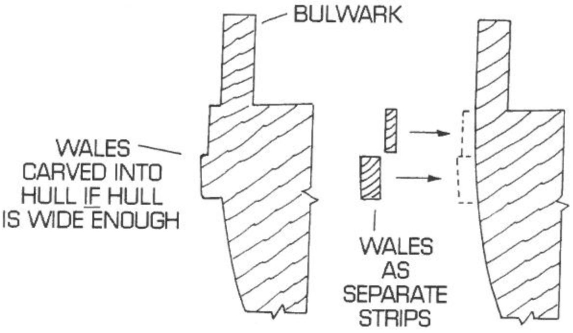

BULWARK
WALES CARVED INTO HULL IF HULL IS WIDE ENOUGH
WALES AS SEPARATE STRIPS

FIG. 3-6 –
ADDING WALES TO A SOLID HULL

Carving the Deck and Bulwarks

Make a cradle to hold the hull securely with its waterline parallel to the baseboard and workbench. Be sure the cradle ends below the waterline. When the time comes, attach a pencil atop a wooden block and slide it along the bench to mark the waterline on the hull.

Ships had open bulwarks (stanchions or timberheads exposed inboard) or ceiled bulwarks (covered with planks and no stanchions exposed). Most machine-carved hulls have thicker-than-normal bulwarks. I've heard this prevents them from being knocked off inside the kit box, but most likely the carving machine couldn't cut to such close tolerances without breaking the wood. Figure 3-7 shows Model Shipways' *Sultana*. Notice how the machine rounded the corners at the forecastle and quarter deck. Deck heights are usually cut to the underside of the cap rail. Carving the exterior hull will reduce the thickness of the bulwarks a little, but if they're still too heavy, remove interior stock until the bulwarks are to scale. If not shown on the plans, you can assume that open bulwarks are about 2" (51mm) thick and ceiled bulwarks about 8" (203mm) thick. This would be 1/32" (0.8mm) or 1/8" (3mm) thick on a 3/16" (1:64) scale model. Thinning the bulwarks is the most difficult part of carving a solid hull, so work slowly to avoid breaking them (Figure 3-8). If you can't carve to this tolerance, consider removing and replacing the bulwarks. Cut notches into the edge of the deck at the station lines, insert your scratch-built stanchions, then plank with a thin wooden sheet. This may be the only solution on a 1/8" (1:96) scale model where the bulwarks are 1/64" (0.4mm) thick.

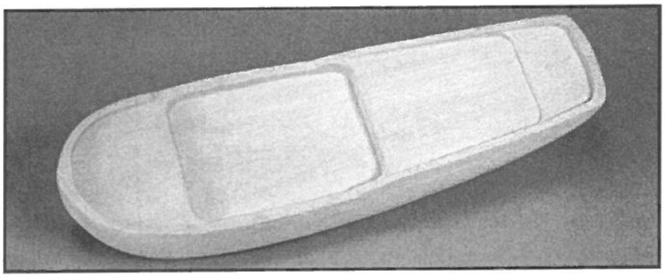


FIG. 3-7 -
SULTANA - MACHINE CARVED HULL

Solid hulls normally have the deck camber carved in. Nevertheless, check it against the plan, shaping with a flat chisel or contoured sanding block if necessary (Figure 3-9). The bow, outboard stern, and deck step corners also require cleaning up, since a round router bit can't cut anything square. Use the same chopping method as for carving the bulwarks (Figure 3-10).

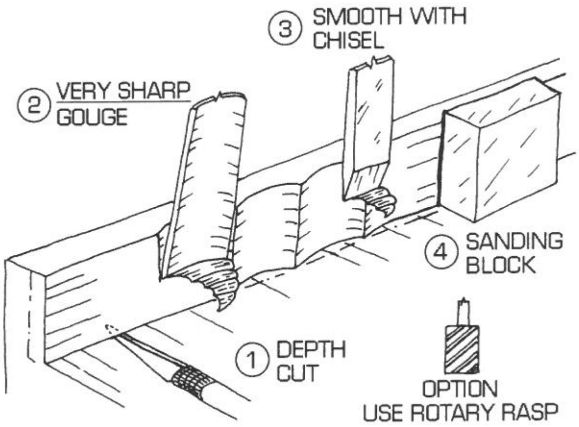


FIG. 3-8 – CARVING THE BULWARKS

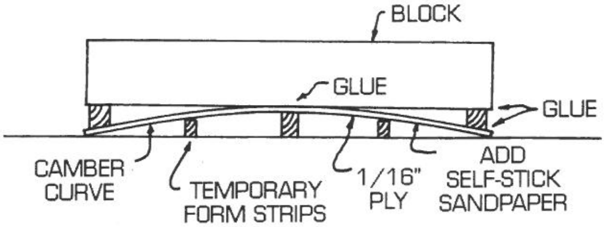


FIG. 3-9 – CAMBER SANDING BLOCK

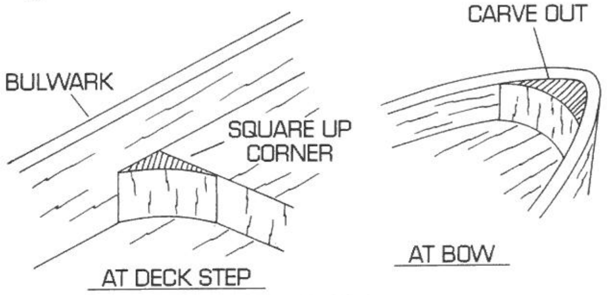
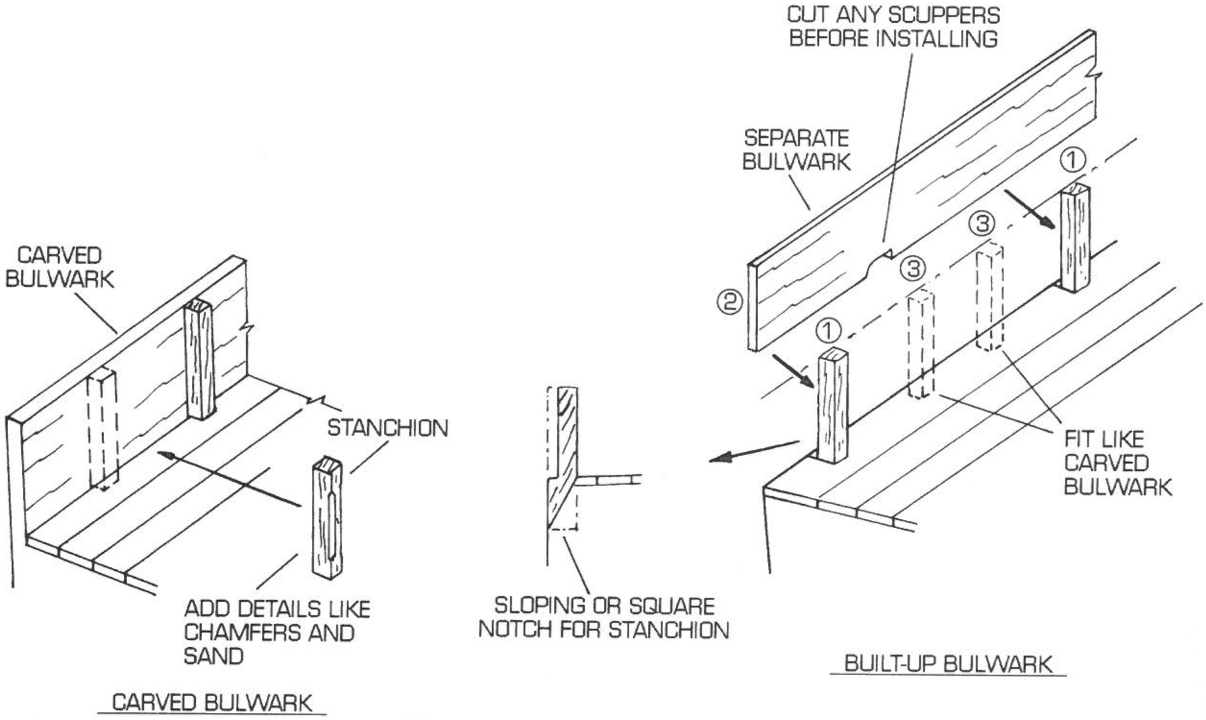


FIG. 3-10 –
CARVING OUT SOME CORNERS

The hull is now fully carved. Go over it with sandpaper, using #220 grit for the final smoothing. Be careful not to round the edges of the rail or rabbet. These should be sharp angles.

Installing the Keel, Stem, and Sternpost

Some kits have a laser-cut keel, stem, and sternpost. If not, cut them out now. Taper the stem and, if required, the sternpost. Even if the plans don't show one, most stems tapered, so add it for historical accuracy. Make sure the wood grain of the stem, sternpost, and keel follows the length of the piece so it won't easily break. Glue and pin the parts simultaneously to the hull. Scrape off excess


CUT ANY SCUPPERS BEFORE INSTALLING
SEPARATE BULWARK
①
③
③
②
①
CARVED BULWARK
STANCHION
ADD DETAILS LIKE CHAMFERS AND SAND
SLOPING OR SQUARE NOTCH FOR STANCHION
FIT LIKE CARVED BULWARK

CARVED BULWARK

BUILT-UP BULWARK

FIG. 3-11 – OPEN BULWARKS

adhesive before it dries. Fill any gaps at the glue joints with wood filler, then sand.

At this stage, drill pilot holes through the keel for the pedestals or other mounting assemblies. If using pedestals, install the screws now. See Chapter 8 on how to mount and display a model.

Mast(s) and Other Holes

Before going any farther, drill all the hull penetrations including holes for the rudder post, bowsprit, and mast(s). Masts usually have some rake to them. To drill mast holes at their proper angles, make a paper or wood template to guide your bit. Other holes are bored as work progresses. For example, the model may have hawse pipes, a galley stack, ventilators, or lifeboat davits. Drill small holes to accept rigging eyebolts or a fitting's mounting leg.

Hull Planking

Refer to the plank-on-bulkhead section, for the procedure is essentially the same.

Planking a Deck

Most solid hull kits supply a scored deck sheet. This makes laying the deck easier for beginners. However, a first-rate model has individual deck planks. I recommend discarding the sheet, because the scores may be too wide for the model's scale, are difficult to color to represent caulking, and may be inappropriate. Some decks curved fore and aft. Most were nibbed, and it's hard to duplicate this feature on scored sheets. Lastly, the scores may not look realistic when abutted against cabin and hatch coamings. Therefore, follow the planking process described in the plank-on-bulkhead section.

Open Bulwarks

If you carved the bulwarks, sand the stanchions, then glue them against the bulwarks to represent planking. If you didn't carve the bulwarks, cut notches along the edge of the deck for each stanchion, or for every third or fourth stanchion. Be sure to attach enough stanchions to support the bulwarks. Lastly, add stanchions between the fixed stanchions. Figure 3-11 shows both methods.

The keys to authentic-looking bulwarks are: Maintain sharp edges on the stanchions. Eliminate any glue that squeezes out around them. Sand everything smooth. Use an airbrush for a flawless paint job. Handmade scrapers are ideal for cleaning up excess glue. Fashion some homemade sanders while you're at it (Figure 3-12). Before starting to paint, clean corners with a brush or blast off the sawdust with an air compressor. Painting over debris ruins scale thickness and rounds edges.

Many bulwark stanchions had chamfered edges. Consider adding them on 1/4" (1:48) or larger scale models. However, they may look more like rounded corners than sharp bevels on smaller scales, so it's better to disregard them. Most other details are similar to modeling a plank-on-bulkhead hull, so look for them below.

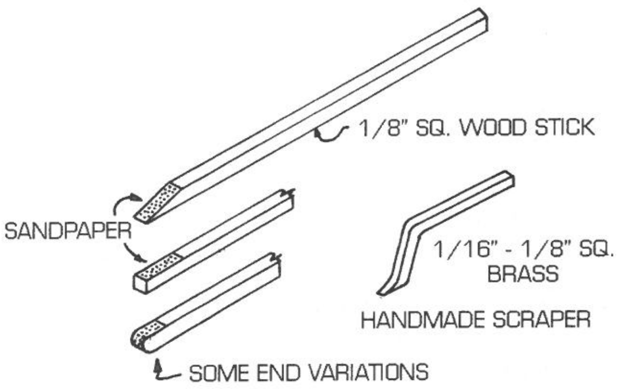


FIG. 3-12 - SANDERS & SCRAPERS

PLANK-ON-BULKHEAD HULLS

Building a plank-on-bulkhead hull requires bending some wood without distorting its desired position (doing so stresses glue joints and fasteners). Wood is bent by:

Steam bending: Hold the plank over a kettle of boiling water and bend. Hold the wood in position until it cools. Although the plank should remain in that shape, it may spring back slightly.

Microwave steaming: Wrap the planks in a wet paper towel before heating. Since microwaves differ in wattage, experiment to determine what power level to use and for how long.

Soaking: Submerge the plank in warm water for several hours. Try adding a little household or pure ammonia. This speeds up the process, making the fibers slippery so the wood bends more easily. After soaking, place the plank in a fixture until completely dry.

Soldering iron: Large soldering irons with a tubular end are ideal. Clamp the iron upright in a vise. While the iron heats, soak the strip of wood in tap water. Some modelers prefer bending around the tube near the handle (it's not as hot), while others use the shank. Move the strip back and forth against the iron. Its heat turns water into steam and drives it into the wood. The trick is to wait until you feel the wood wanting to yield before starting the bend. Begin too soon or apply too much pressure and the strip will break. The wood dries rapidly, so care must be taken to avoid scorching. Resoak and reapply it to the iron until the desired shape is achieved. Once the piece is formed, it can go directly on the model. Because the wood's memory has been permanently altered, it will never spring back to its former shape, meaning no stress on any timber or fasteners. Spend some time acquainting yourself with this method and you'll never bother with fixtures again.

Another popular soldering iron approach is to turn a tip (5/16" to 3/8" in diameter with a 1/8" shank to fit the iron) from hard aluminum, then file a 45° angle on one end. Insert the tip in a 30-watt soldering iron and heat it. Soak the wood for five or 10 minutes, then let dry for about the same time. Woods take on water faster than they can release it, so they won't completely dry out. Hold the tip against the wood to heat it. When supple, bend the plank over a form, or simply lift the end as heat is applied and bend by hand. Such an aluminum tip, called a Kammerlander after its German inventor, is available in the U.S.

Commercial plank benders: Model Expo sells an electric plank bender designed for controlled heat. Another tool (Amati's Form-A-Strip available from Model Expo) bends planks without soaking or heating. It looks like a pair of pliers with one flat jaw and a chisel for the other. When squeezed on a plank, the chisel depresses one side of the wood, causing it to bend. Repeat the process along the plank until it assumes the correct curve. However, squeezing too hard will cut the wood in half. This tool bends planks in only one direction, so it's good for bow planks, but not those at the stern.

Center Keel Assembly

Center keels come as a single unit or in several pieces so they fit in the box. If the latter is the case, the important issue is to assemble the keel so it precisely matches the plans. Some plans show a reference line, but if they don't, draw your own. Lay a sheet of waxed paper or plastic wrap over a flat building board or table, and place the center keel pieces on top. Affix the joints with white or woodworker's glue. Use a steel or aluminum straightedge to align the reference line. Place a weight on each piece to hold it down while the glue dries overnight.

With a sharp pencil, mark the bulkhead locations on both sides of the center keel below the slots. Although these hulls are normally assembled like an egg crate, bulkheads can wobble. Reference lines prevent you from gluing them in the wrong positions.

Installing the Stem, Keel, and Sternpost

Some kits include the stem, keel, and sternpost as part of the center keel. If not, taper the stem and sternpost before installing. Use dowels to align the parts.

Cutting a Rabbet

A model's design may or may not require cutting a rabbet so the hull planks lie flush against the bulkheads. However, it's a good idea to cut one regardless. A rabbet produces a sound joint for the planks and avoids tapering edges and ends. It doesn't take long to do, but let's first define a rabbet (Figure 3-13).

For the model with a separate stem, keel, and sternpost, the rabbet is the glue line between them and the center keel. The bearding line is the intersection of the center keel with the planking's inner face. Measure the bearding line's location from the plans (if shown), then mark it on both sides of the center keel. It also appears along the stem, keel, and sternpost.

Models requiring a rabbet or with an all-inclusive keel will show it on the plans; otherwise, lay out the cut yourself. If the plans don't have a bearding line, develop one from the waterlines and station lines (Figure 3-14). It isn't hard. The most wood removed for the rabbet is at the stern.

Use a hobby knife and narrow flat chisel to cut the rabbet. A rabbet doesn't have to be precise. It's permissible to take shortcuts, like eliminating the middle line at the bow and stern. All that's really necessary along the keel is that plank edges seat snugly into the groove. Start chiseling at the bearding line and work toward the rabbet (Figure 3-15). The angle will vary depending upon the rabbet's location. To judge this angle, lay a scrap plank against the keel as you carve. When the hull is planked, these timbers should lie flush on the cut portion

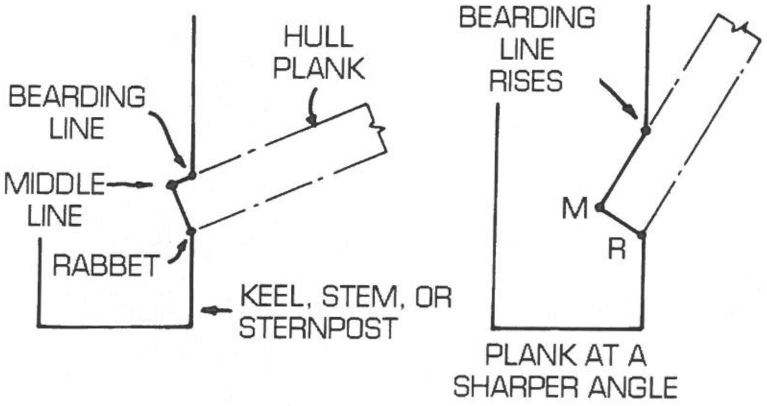

BEARDING LINE
MIDDLE LINE
RABBET
HULL PLANK
KEEL, STEM, OR STERNPOST
BEARDING LINE RISES
M
R
PLANK AT A SHARPER ANGLE

FIG. 3-13 – RABBETS

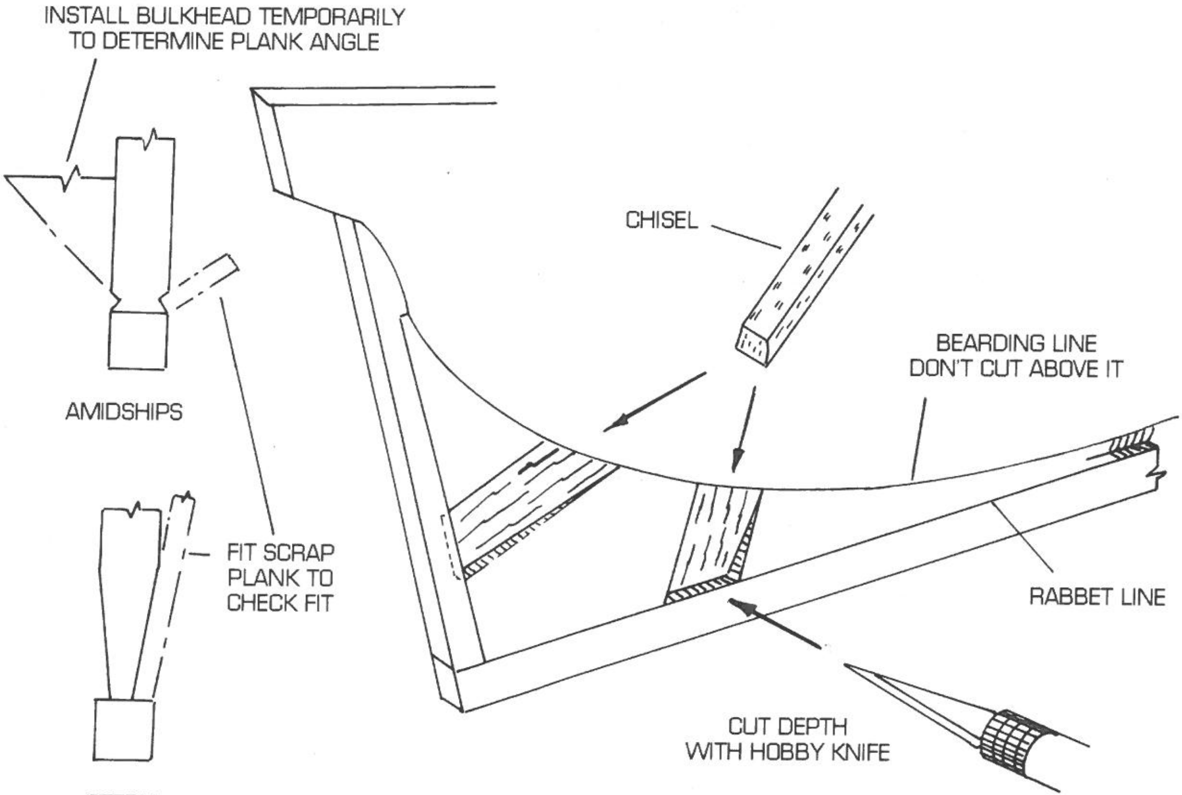
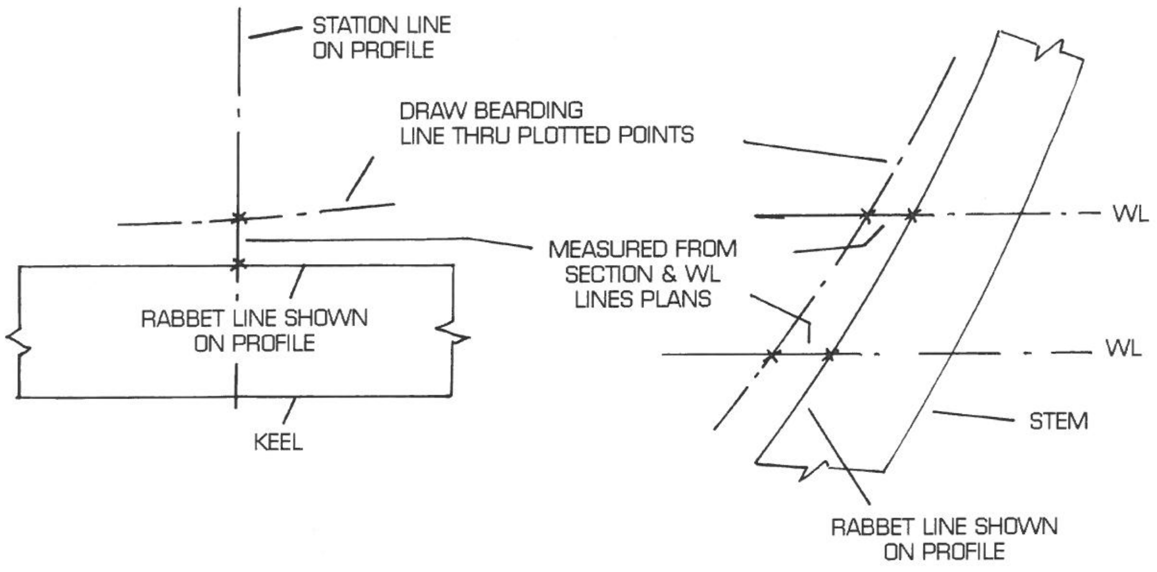
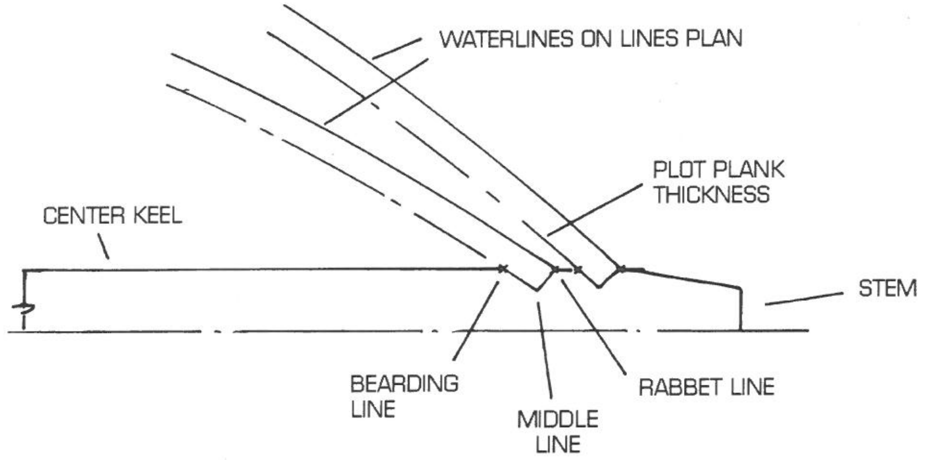

INSTALL BULKHEAD TEMPORARILY TO DETERMINE PLANK ANGLE
AMIDSHIPS
FIT SCRAP PLANK TO CHECK FIT
STERN
CHISEL
BEARDING LINE DON'T CUT ABOVE IT
RABBET LINE
CUT DEPTH WITH HOBBY KNIFE

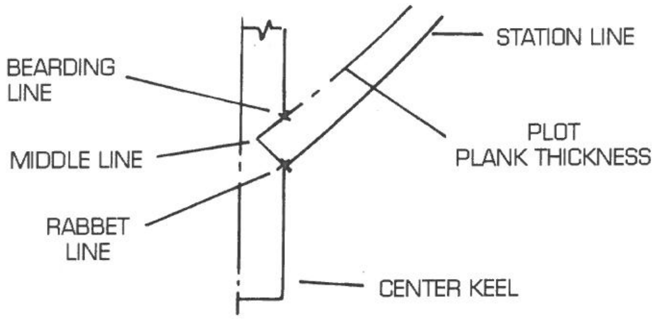
FIG. 3-15 - CUTTING THE RABBET


STATION LINE
ON PROFILE
DRAW BEARDING
LINE THRU PLOTTED POINTS
MEASURED FROM
SECTION & WL
LINES PLANS
RABBET LINE SHOWN
ON PROFILE
KEEL
WL
WL
STEM
RABBET LINE SHOWN
ON PROFILE

3. PLOT POINTS MEASURED FROM STATION LINES & WATERLINES ONTO PROFILE PLAN


WATERLINES ON LINES PLAN
PLOT PLANK
THICKNESS
CENTER KEEL
STEM
BEARDING
LINE
MIDDLE
LINE
RABBET LINE

2. FINDING THE BEARDING LINE FROM WATERLINES


STATION LINE
BEARDING
LINE
MIDDLE LINE
RABBET
LINE
PLOT
PLANK THICKNESS
CENTER KEEL

1. FINDING THE BEARDING LINE FROM STATION LINES

FIG. 3-14 – DEVELOPING A RABBET FROM A LINES DRAWING

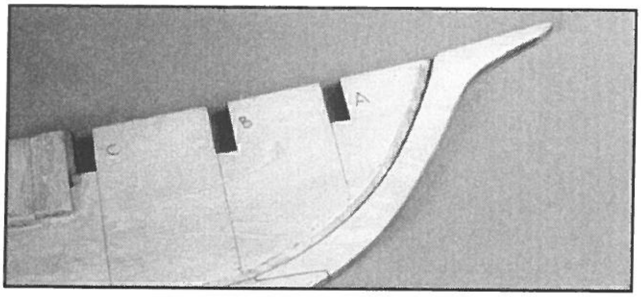


FIG. 3-16 - PRIDE OF BALTIMORE II - RABBET DETAIL IN CENTER KEEL

from bearding line to rabbet. Cut the groove along the keel between the rabbet and bearding line with a narrow 1/8″ (3mm) wide chisel.

Figure 3-16 shows Model Shipways' *Pride of Baltimore II* with the rabbet cut completed along the forward portion of the center keel.

Installing the Bulkheads

Test each bulkhead to make sure it slides into the correct center keel slot. If the fit is too tight, sand the slot. Bulkheads should seat snugly with a little tolerance for glue.

Mark the reference lines, if given on the plans, in pencil on each bulkhead. They must align with the reference line marks on the center keel and correctly relate to one another. This assures an accurate hull. Try to develop a reference line for kits without one. If the slots in the keel and bulkheads are not precise, some bulkheads could be too high and others too low. Then the hull's shape isn't fair.

Next, use a tick strip (piece of calculator tape) to transfer the bevels from the plans to the bulkheads. Mark them in pencil. Figure 3-17 illustrates the bevel and how to develop it from the waterlines. Cut the bevels with a #11 hobby knife blade (Figure 3-18). Deck bevels and side bevels amidships are hardly measurable. Sand these in after the bulkheads are installed. Glue the bulkheads in place. Make sure each bulkhead's reference line matches the one on the center keel. Use a small machinist's square to set each bulkhead perpendicular to the center keel, then tack a temporary strip to the top of the bulkhead to hold it in place while the glue dries (Figure 3-19).

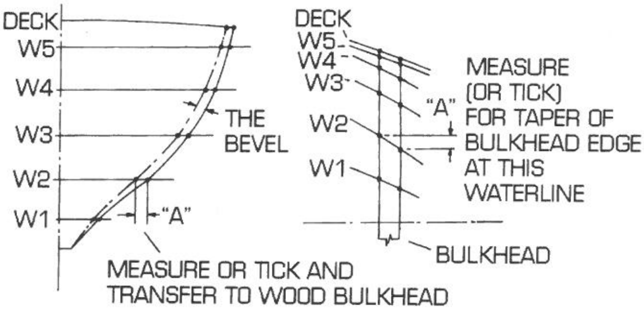

DECK
W5
W4
W3
W2
W1
THE BEVEL
"A"
MEASURE OR TICK AND TRANSFER TO WOOD BULKHEAD
DECK
W5
W4
W3
W2
W1
"A"
MEASURE (OR TICK) FOR TAPER OF BULKHEAD EDGE AT THIS WATERLINE
BULKHEAD

FIG. 3-17 – BULKHEAD BEVELS

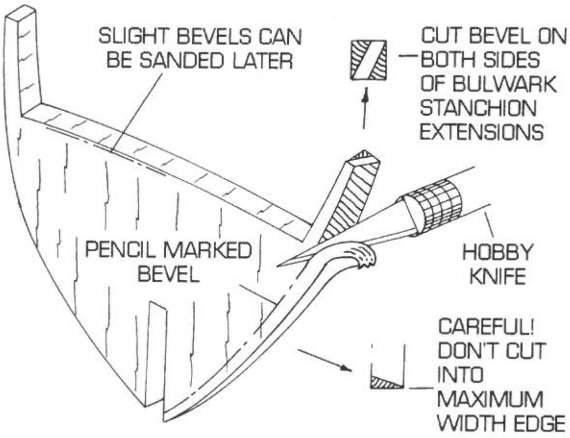

SLIGHT BEVELS CAN BE SANDED LATER
CUT BEVEL ON BOTH SIDES OF BULWARK STANCHION EXTENSIONS
PENCIL MARKED BEVEL
HOBBY KNIFE
CAREFUL! DON'T CUT INTO MAXIMUM WIDTH EDGE

FIG. 3-18 – CUTTING BULKHEAD BEVELS

After installing all the bulkheads, tack or tape a temporary batten on each side of the hull just below the deck. Measure the spacing between each port and starboard bulkhead, and retack the battens until the hull is aligned. Although the center keel was assembled flat, it could warp and produce a banana-shaped hull. When it looks correct, check it again. Be certain the bottom of each bulkhead feathers out at the bearding line. Trim as necessary to line up.

Optional: After the bulkheads are properly aligned, add permanent struts between each. A strut approximately 3/16″ (5mm) square should be sufficient.

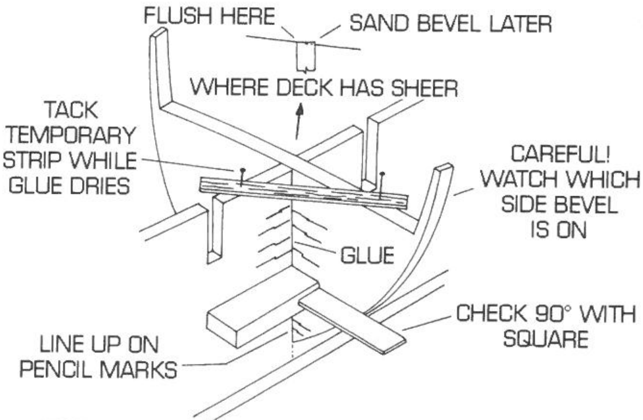

FLUSH HERE
SAND BEVEL LATER
WHERE DECK HAS SHEER
TACK TEMPORARY STRIP WHILE GLUE DRIES
CAREFUL! WATCH WHICH SIDE BEVEL IS ON
GLUE
CHECK 90° WITH SQUARE
LINE UP ON PENCIL MARKS

FIG. 3-19 – INSTALLING BULKHEADS

Figure 3-20 shows Model Shipways' *Charles W. Morgan* with bulkheads and keel in place. This is a design hull, so don't scrutinize it too closely. I batter them around quite a bit making corrections and refining the plans.

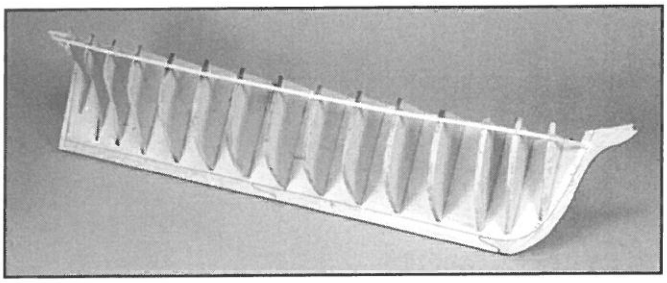


FIG. 3-20 - CHARLES W. MORGAN - BULKHEADS ON CENTER KEEL

Next, sand in the bevels that were not precut. To recheck the hull's shape, lay a 1/8" (3mm) square basswood batten against the bulkhead edges and decks at various locations (Figure 3-21). Sand or add shims to correct bumps and dips. This is an important check. Hull planks must lie flat against the bulkheads.

Installing Bow and Stern Filler Blocks

Many kits supply balsa wood or basswood filler blocks to provide a solid base for timberheads, knightheads, and hull planks at the bow and stern. Planks will still require steam bending at the stem and stern, but are less likely to crack with the blocks in place (Figure 3-22). If the kit doesn't include them or comes with balsa blocks, carve your own from basswood. (Balsa is too soft to hold fasteners securely.) If templates for the blocks are not shown on the plans, make your own from the waterlines to determine their correct shape.

Installing Stern Framing

A hull's design establishes its stern structure. The primary concern is to achieve a symmetrical stern, meaning port and starboard are identical. Measure from the centerline. Figure 3-23 illustrates some variations in model framing.

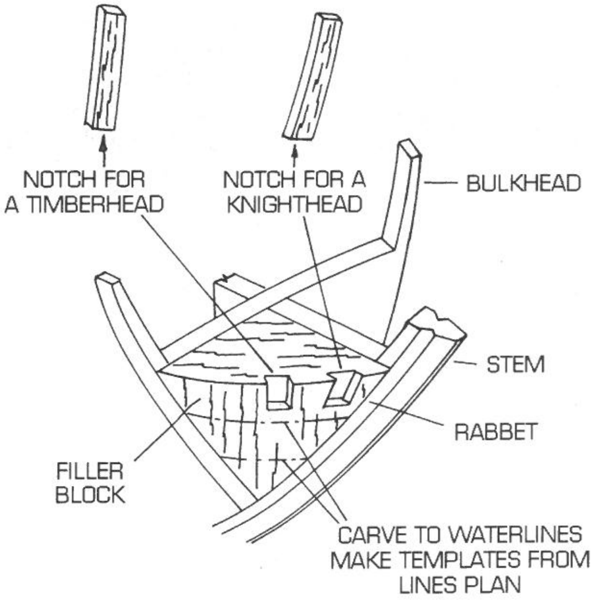

NOTCH FOR A TIMBERHEAD
NOTCH FOR A KNIGHTHEAD
BULKHEAD
STEM
RABBET
FILLER BLOCK
CARVE TO WATERLINES MAKE TEMPLATES FROM LINES PLAN

FIG. 3-22 – BOW FILLER BLOCK

Covering Mast Slots

If the center keel contains slots for the masts, glue pieces on both sides of each opening to form a snug socket (Figure 3-24). Fit and attach them securely, because they are inaccessible once the decking is installed.

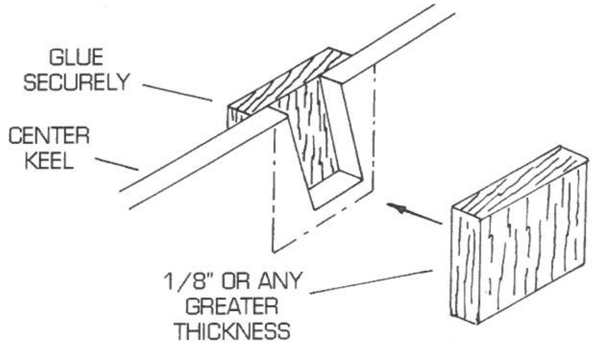

GLUE SECURELY
CENTER KEEL
1/8" OR ANY GREATER THICKNESS

FIG. 3-24 – MAST MORTISE

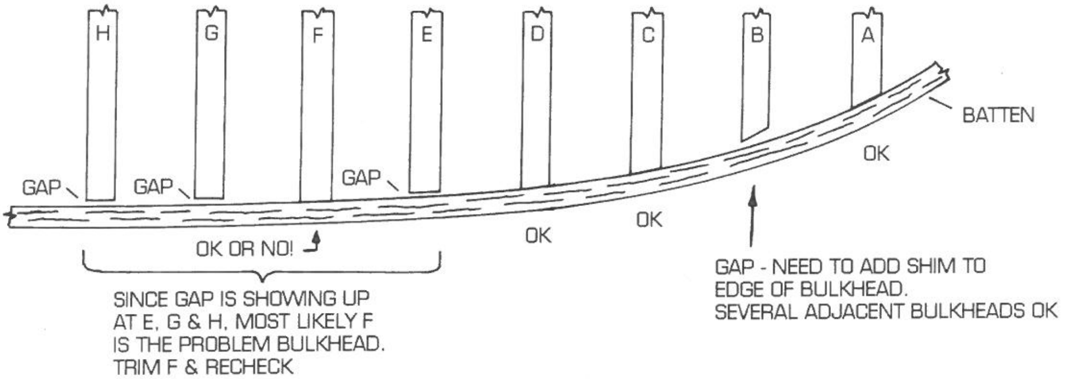
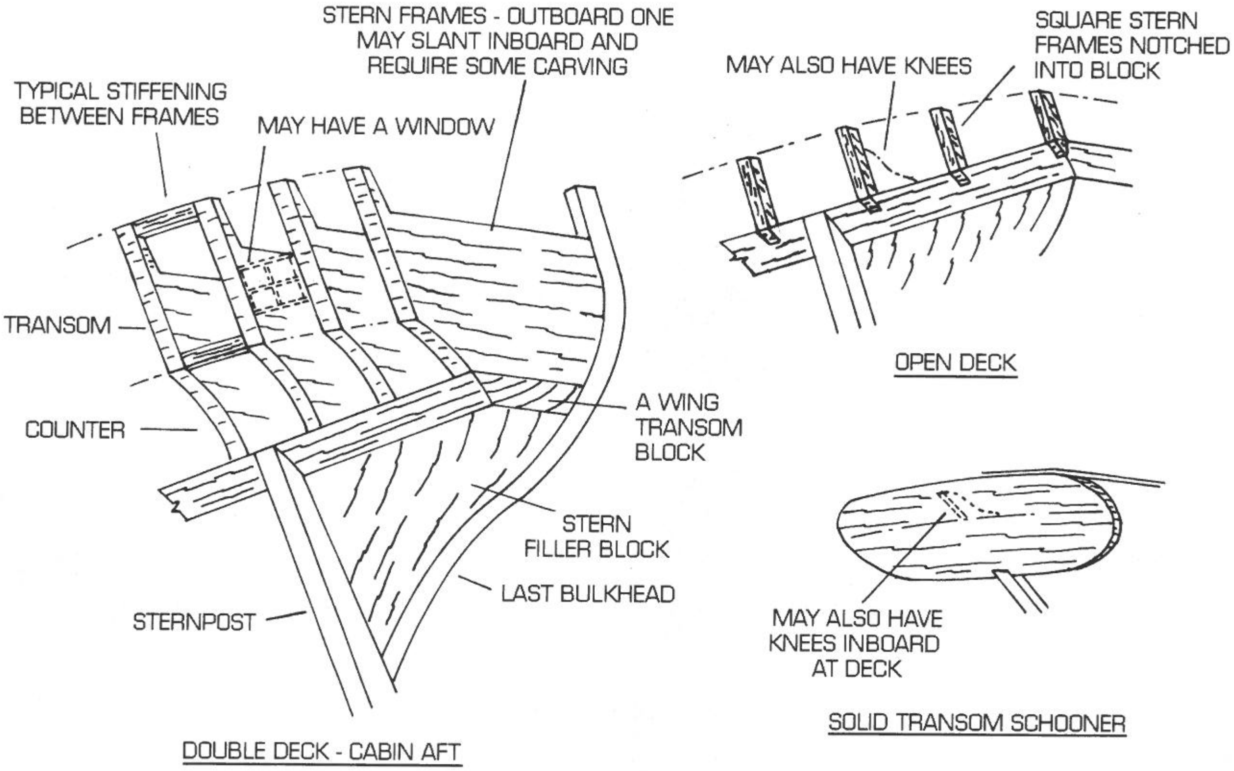

H
G
F
E
D
C
B
A
BATTEN
GAP
GAP
GAP
OK
OK
OK
OK OR NO!
SINCE GAP IS SHOWING UP AT E, G & H, MOST LIKELY F IS THE PROBLEM BULKHEAD. TRIM F & RECHECK
GAP - NEED TO ADD SHIM TO EDGE OF BULKHEAD. SEVERAL ADJACENT BULKHEADS OK

FIG. 3-21 – FAIRING THE BULKHEADS

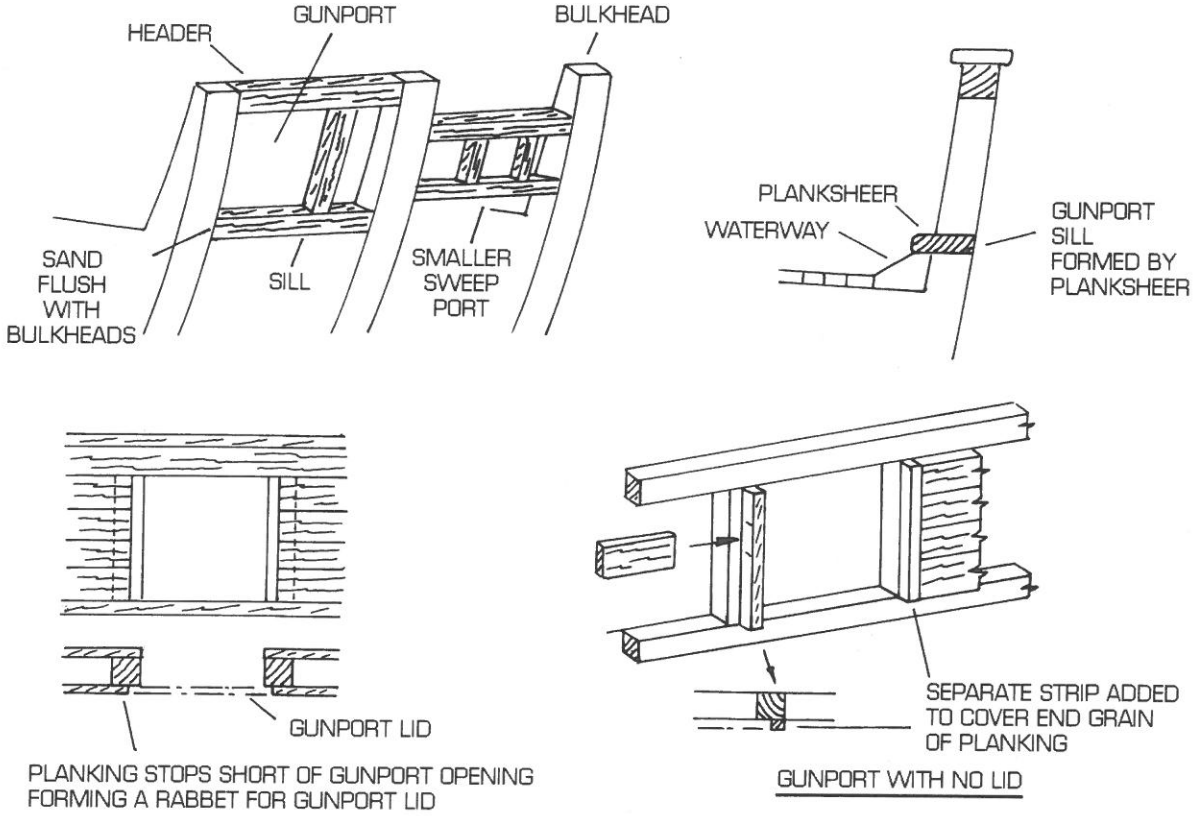

STERN FRAMES - OUTBOARD ONE MAY SLANT INBOARD AND REQUIRE SOME CARVING
TYPICAL STIFFENING BETWEEN FRAMES
MAY HAVE A WINDOW
TRANSOM
COUNTER
A WING TRANSOM BLOCK
STERN FILLER BLOCK
LAST BULKHEAD
STERNPOST
MAY ALSO HAVE KNEES
SQUARE STERN FRAMES NOTCHED INTO BLOCK
MAY ALSO HAVE KNEES INBOARD AT DECK

DOUBLE DECK - CABIN AFT

OPEN DECK

SOLID TRANSOM SCHOONER

FIG. 3-23 – SOME VARIATIONS IN STERN FRAMING


HEADER
GUNPORT
BULKHEAD
SAND FLUSH WITH BULKHEADS
SILL
SMALLER SWEEP PORT
PLANKSHEER
WATERWAY
GUNPORT SILL FORMED BY PLANKSHEER
GUNPORT LID
PLANKING STOPS SHORT OF GUNPORT OPENING FORMING A RABBET FOR GUNPORT LID
SEPARATE STRIP ADDED TO COVER END GRAIN OF PLANKING

GUNPORT WITH NO LID

FIG. 3-25 – SOME GUNPORT & SWEEP PORT DETAILS

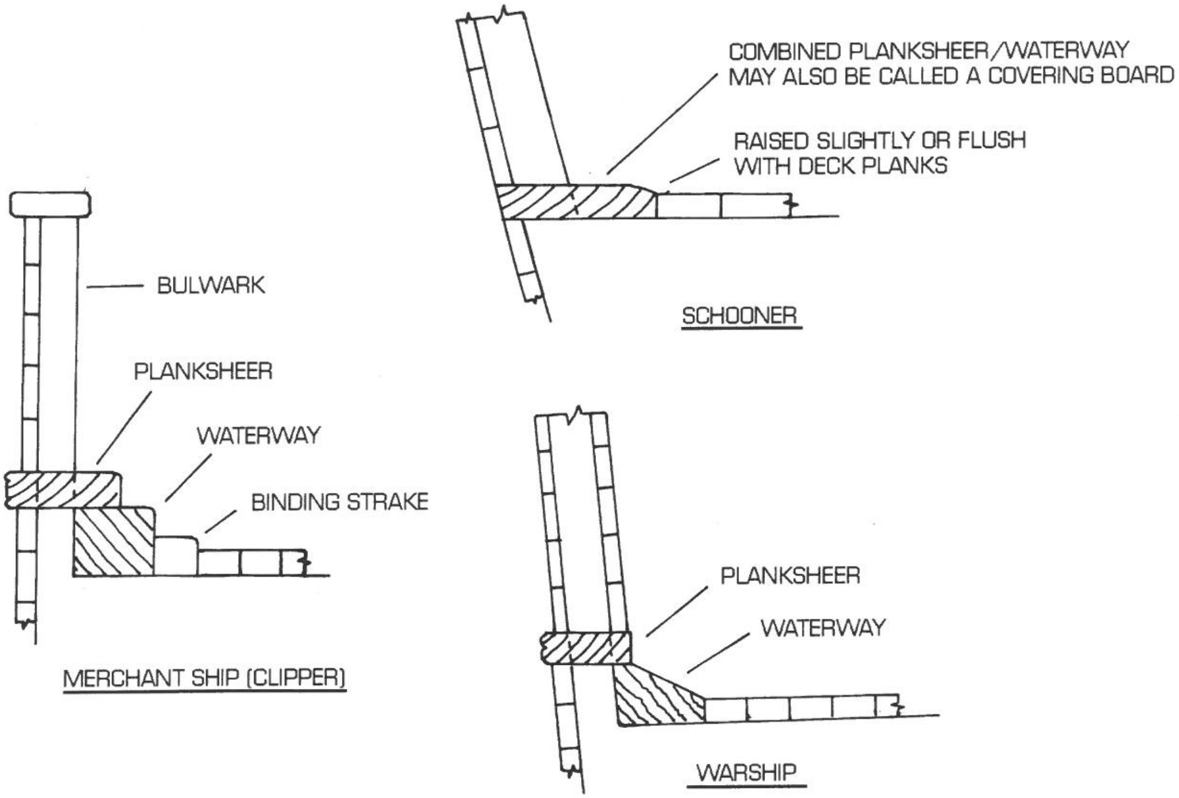

COMBINED PLANKSHEER/WATERWAY
MAY ALSO BE CALLED A COVERING BOARD
RAISED SLIGHTLY OR FLUSH
WITH DECK PLANKS
SCHOONER
BULWARK
PLANKSHEER
WATERWAY
BINDING STRAKE
MERCHANT SHIP (CLIPPER)
PLANKSHEER
WATERWAY
WARSHIP

FIG. 3-26 – VARIATIONS IN PLANKSHEERS & WATERWAYS

Framing Gunports and Sweep Ports

Some kits supply preformed wood or metal boxes for framing gunports and possibly sweep ports. If not, build the boxes from stripwood. Occasionally, a bulkhead forms one or both sides of a gunport. How the gunports and sweep ports align is important. Use a long batten to mark the locations of upper and lower sills, so the ports line up according to the plan.

Install the upper and lower sills at the marked bulkheads. In way of bulwarks, fit the pieces flush with the timberheads on the inboard side. The outboard side can protrude beyond the timberheads a bit. Just remember to sand them flush, because the hull planking must lie flat against the gunport frames.

Fit the vertical sides in the same manner. Mark the sill locations according to the plan, and make sure the angles are correct or square. Depending on the design, the vertical framing may seat flush with the upper and lower sills, but have a separate piece covering the planking's end grain. If the gunport has a lid, the planks may stop short of the opening to form a rabbet for the lid. Figure 3-25 illustrates variations in gunport and sweep port framing.

Installing Waterways and Planksheers

Waterways and planksheers differ depending on the ship type and design (Figure 3-26). How they're installed also varies. Waterways usually run inboard of the timberheads and must be carved to reflect how the timberheads curve fore and aft (Figure 3-27). (One option is to slope the waterway only in way of the bulkheads). Waterways on schooners with open bulwarks are often notched to fit around the timberheads. Occasionally, timberheads require building the planksheer in several pieces. This isn't as awful as it sounds, because the planksheer is often in line with a gunport sill, so that portion is already installed. Like the waterway, planksheer edges may require shaping to follow the curve of the hull.

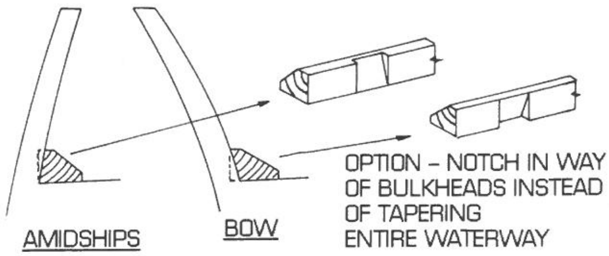

OPTION – NOTCH IN WAY
OF BULKHEADS INSTEAD
OF TAPERING
ENTIRE WATERWAY
AMIDSHIPS
BOW

FIG. 3-27 – CHANGING ANGLES OF WATERWAY

The planksheer, waterway, and binding strakes (as shown on Figure 3-26) are important details. Though a little difficult to install, they should never be omitted. If the plans don't show these details, consult other references to determine what was typical on your type of ship, then add them.

Installing Main and Other Rails

Most often, laser- or die-cut bulkheads include the timberheads. They usually extend to the main rail or even the topgallant rail. In the latter, the main rail consists of three strips, or a strip inboard and outboard of the timberheads. When installing the rails, keep in mind their proper width. Rails generally overhang the planking, and right now the hull isn't planked. Use pins or dowels to align and hold the rail in place.

Many rails have one or two grooves along the edge. Add this moulding if the scale permits. Cut a simple groove with a scraper made from shim stock or a single-edge razor (Figure 3-28).

PLANKING A

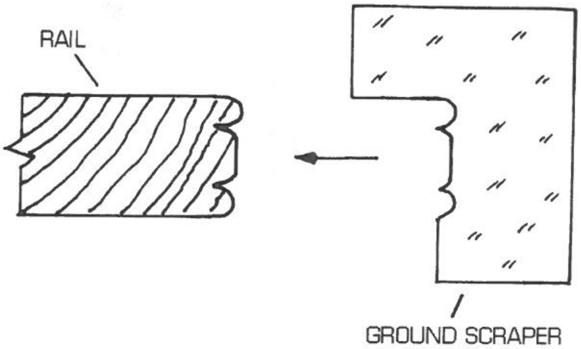


FIG. 3-28 – GROOVING RAILS

PLANK-ON-BULKHEAD MODEL

Before starting, invert the hull and secure it in a vise or cradle. Something portable that rotates is ideal. While most modelers find planking tedious, just work slowly and think of each plank as a project unto itself. Since hull sides are identical, simultaneously cut one pair of port and starboard planks to shape. Fit the plank on one side, then the other. Don't rush. Speed results in frustration and a poor job.

Planking Battens and Belts

Hulls are easier to plank when divided into belts. They flow along the hull in smooth curves. Each is designed to lay the planks against the bulkheads without excessive edge bending. They sweep gently up at the ends like the deck sheer. Planks within a belt are usually evenly spaced, tapered, and fitted.

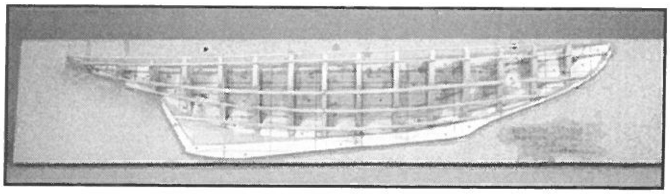


FIG. 3-29 – BENJAMIN LATHAM - DESIGN MODEL WITH PLANK BELT BATTENS

Belts prevent errors from accumulating. Figure 3-29 and 3-30 show the half hull layout I did when developing the planking belts for Model Shipways' *Benjamin Latham* kit (the hull has seen better days). Markings on the midship bulkhead indicate how many planks to install between the battens. Figure 3-31 illustrates typical belt layouts for various ship types.

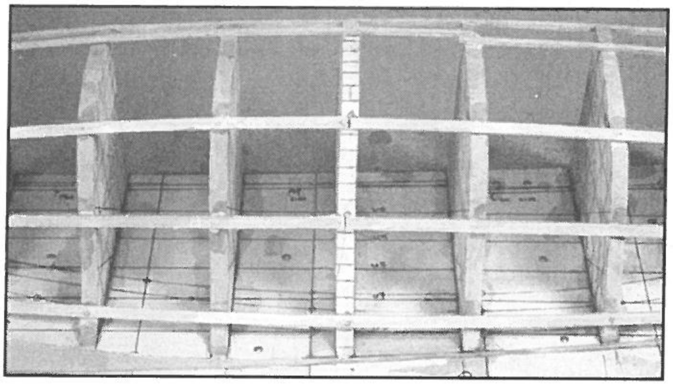


FIG. 3-30 – BENJAMIN LATHAM - DESIGN MODEL. CLOSE-UP OF BATTENS AND PLANKMARKS

When selecting a belt width and the number of planks it contains, consider how the planks taper and lay against the bulkheads. If the planks are too wide, they won't lie flat. Taper them too much and not enough stock is left for fastening. Should this happen, a larger plank must be substituted for two planks to increase the width. In some areas, the distance between planks widens rather than tapers. If it becomes too wide, a stealer must be added. While these alterations are acceptable and employed on many ships, the best run of planking limits the number of stealers. Figure 3-32 illustrates some inserts.

Some kit plans provide a fore, aft, and profile view of the hull planking. Figure 3-33 and 3-33a show Model Ship-ways' *Emma C. Berry* kit. If the plans lack this information, seek help from other modelers or buy a book (Appendix A) on how to develop a planking layout.

Planking Butts

Few trees grow as tall as ships are long. Consequently, real planks were generally 20 or 30 feet in length. Some modelers think a plank as long as the hull is easier to use. They scribe in fake butts or omit them. Although this can be done, working with shorter planks has advantages.

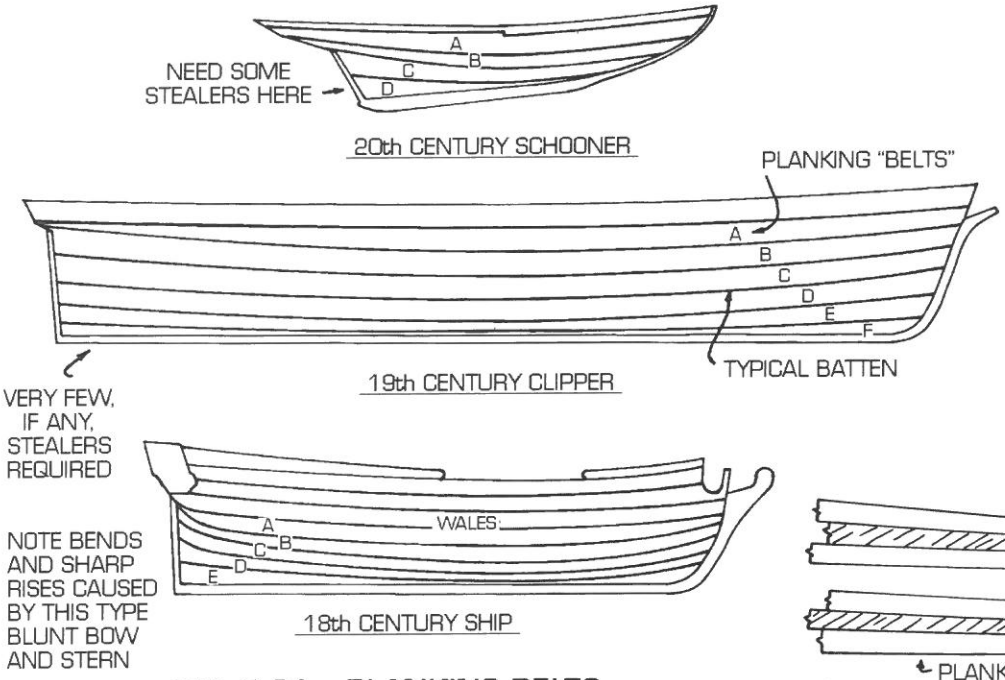

NEED SOME STEALERS HERE
A
B
C
D
20th CENTURY SCHOONER
PLANKING "BELTS"
A
B
C
D
E
F
TYPICAL BATTEN
19th CENTURY CLIPPER
VERY FEW, IF ANY, STEALERS REQUIRED
WALES
A
B
C
D
E
NOTE BENDS AND SHARP RISES CAUSED BY THIS TYPE BLUNT BOW AND STERN
18th CENTURY SHIP

FIG. 3-31 – PLANKING BELTS

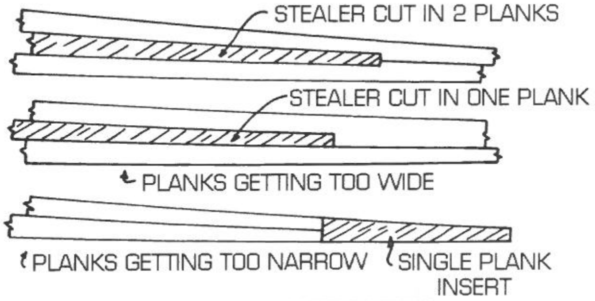
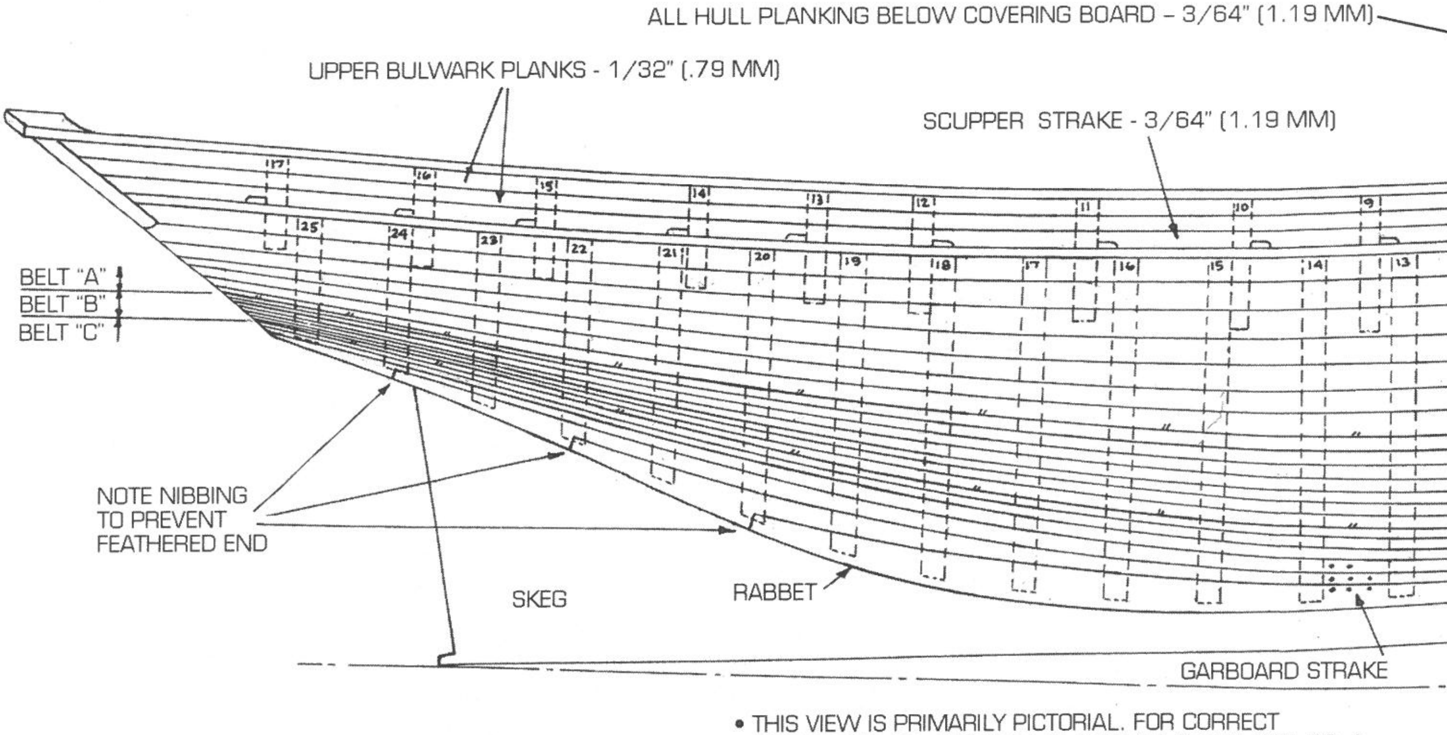

STEALER CUT IN 2 PLANKS
STEALER CUT IN ONE PLANK
PLANKS GETTING TOO WIDE
PLANKS GETTING TOO NARROW
SINGLE PLANK INSERT

FIG. 3-32 – STEALERS


ALL HULL PLANKING BELOW COVERING BOARD – 3/64" (1.19 MM)
UPPER BULWARK PLANKS - 1/32" (.79 MM)
SCUPPER STRAKE - 3/64" (1.19 MM)
17
16
15
14
13
12
11
10
9
25
24
23
22
21
20
19
18
17
16
15
14
13
BELT "A"
BELT "B"
BELT "C"
NOTE NIBBING TO PREVENT FEATHERED END
SKEG
RABBET
GARBOARD STRAKE

• THIS VIEW IS PRIMARILY PICTORIAL. FOR CORRECT PLANK WIDTHS, USE HULL PLANKING LAYOUT. (FIG. 33-a)

NOTE THAT ALL PLANK LINES REPRESENT THE INSIDE EDGE ON THE FRAME, EXCEPT FOR THE RABBET WHICH IS THE OUTSIDE EDGE

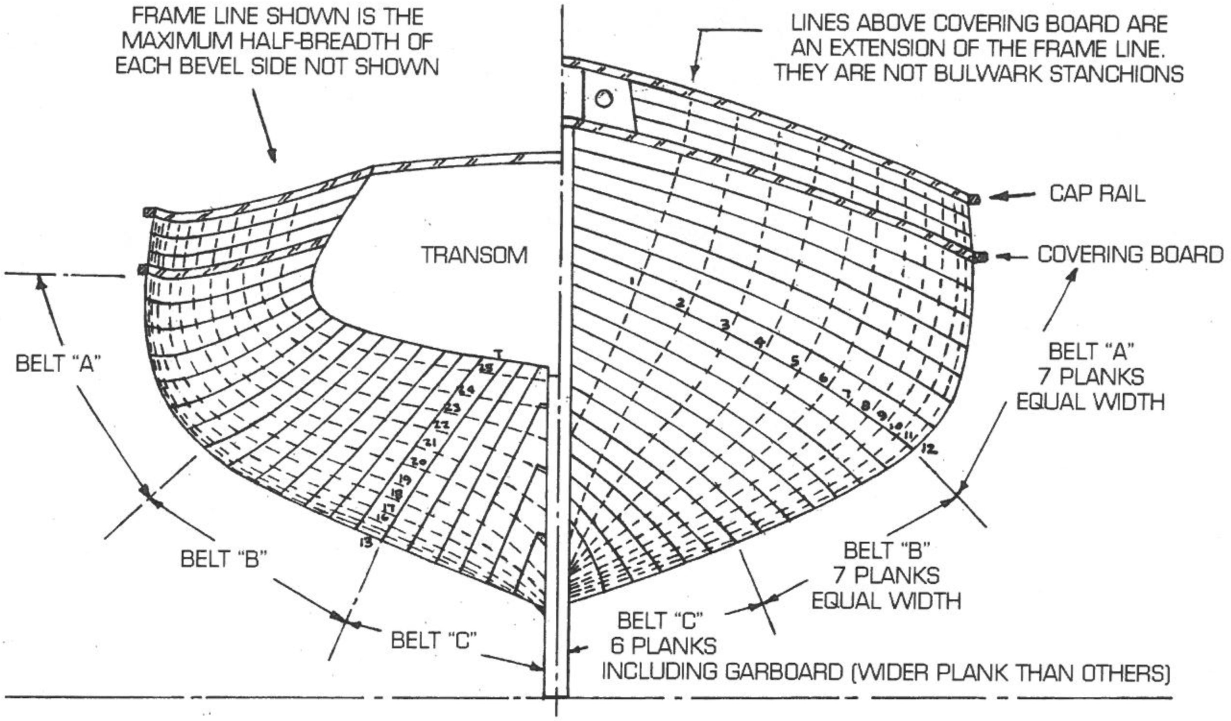
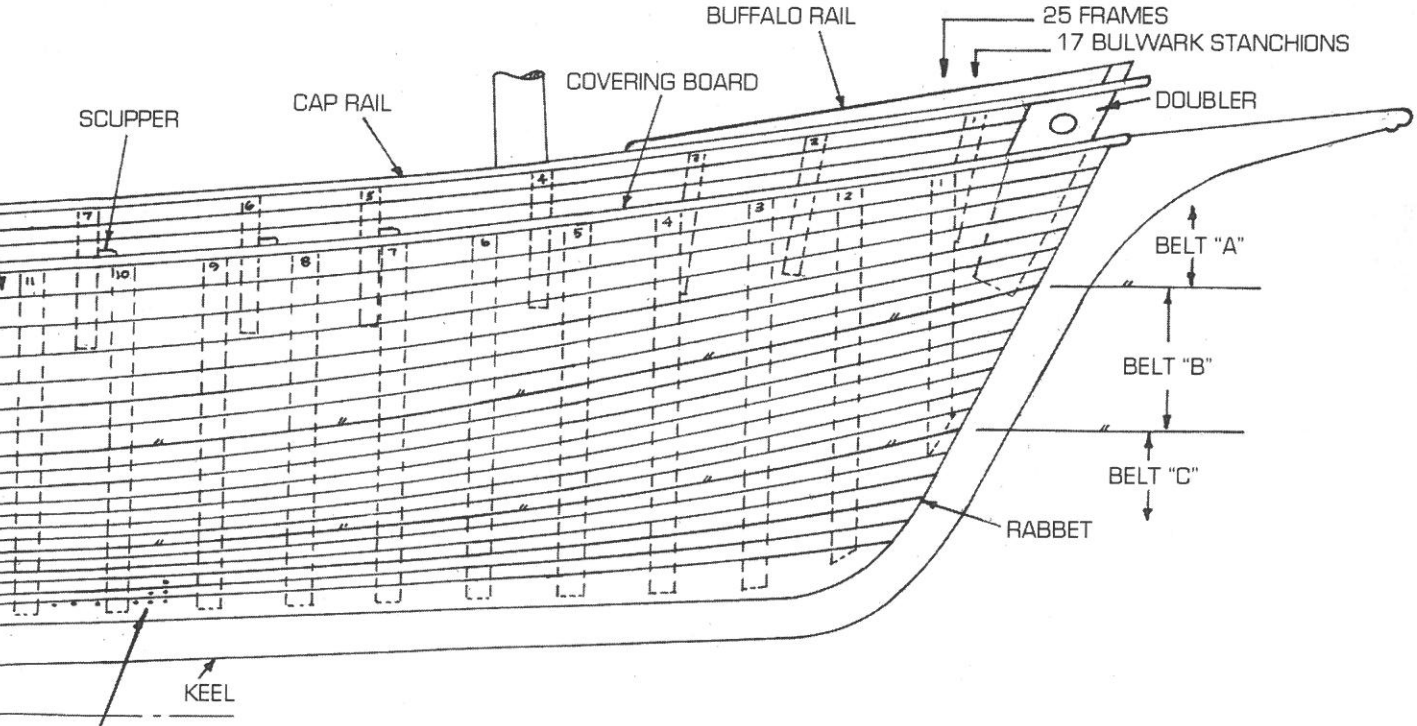

FRAME LINE SHOWN IS THE MAXIMUM HALF-BREADTH OF EACH BEVEL SIDE NOT SHOWN
LINES ABOVE COVERING BOARD ARE AN EXTENSION OF THE FRAME LINE. THEY ARE NOT BULWARK STANCHIONS
CAP RAIL
TRANSOM
COVERING BOARD
BELT "A"
BELT "A"
7 PLANKS
EQUAL WIDTH
BELT "B"
BELT "B"
7 PLANKS
EQUAL WIDTH
BELT "C"
BELT "C"
6 PLANKS
INCLUDING GARBOARD (WIDER PLANK THAN OTHERS)

FIG. 3-33a
HULL PLANKING LAYOUT - EMMA C. BERRY


BUFFALO RAIL
25 FRAMES
17 BULWARK STANCHIONS
COVERING BOARD
DOUBLER
CAP RAIL
SCUPPER
BELT "A"
BELT "B"
BELT "C"
RABBET
KEEL

APPX. 130 HOLES PER SIDE, 1/32" (.79 MM) DIA. DRILLED IN WAY OF WET WELL, SO WELL WILL BE FREE FLOODING

HULL PLANKING PROFILE

FIG. 3-33
EMMA C. BERRY PLANKING

For example, tapers mark quicker and planks are easier to hold and fasten. Should a mistake occur, only a small piece is affected. So, the following is based on scale-length planks.

Because this is a plank-on-bulkhead hull, planking butts must occur on bulkheads and won't simulate shipwright practice. Therefore, cover four bulkhead spaces with one plank. To avoid stubby pieces at the bow and stern, use a longer or shorter plank to complete the run.

To emulate shipwright practice, stagger the butts (Figure 3-34). This also applies to deck planking.

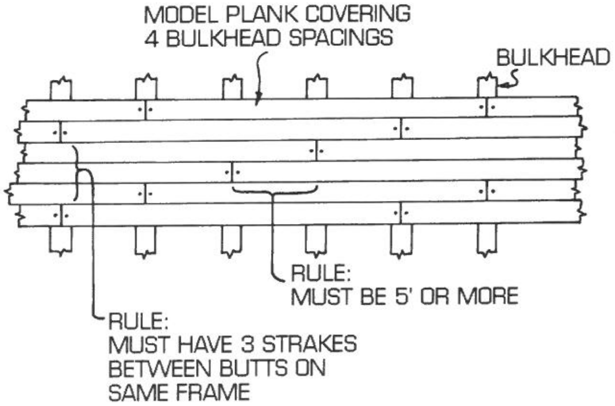


FIG. 3-34 – PLANKING BUTTS

Covering four bulkhead spaces follows the rule of three full plank widths between butts on a single frame (or bulkhead, in our case). One plank covering three bulkhead spaces won't work, because that leaves only two full planks between butts.

Spiling

Edge bending planks on real ships occurs on a limited basis. Wood is rigid, so many planks must be cut to shape. Spiling (Figure 3-35) is simply a matter of transferring curves to a straight plank, then sawing them out. Usually, model planking strips are flexible enough to edge bend in place. Basswood is a little easier to bend than a stiffer wood like walnut.

One reasonably accurate alternative to spiling is laying a piece of paper over the plank already in place. Press your finger press along the edge of the plank to make an indent in the paper. Cut along this crease and lay it over your new plank.

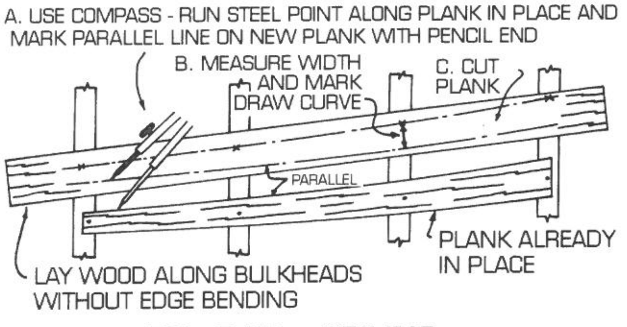


FIG. 3-35 – SPILING

Fastening the Planks

Avoid the commercial plank clamp that screws into the edges of bulkheads. This leaves a big hole to contend with when installing subsequent planks. Instead, hold the planks and use aluminum-head push pins to position them. Be careful not to split the wood. If necessary, drill a pilot hole first. Smear a light film of white or woodworker's glue along the edge of the plank with your finger, then touch each bulkhead with thin cyano to affix the plank quickly. Be careful not to glue your fingers to the model.

Another approach is to apply cyano to the edge of a plank already in place and to the bulkheads above it. Spray or brush the cyano's accelerator on the plank to be installed, then hold it in place. The glue sets instantly and no clamps are necessary. While glue alone will secure a plank, small brass brads or wooden treenails provide additional holding power and duplicate shipwright practice. If using brads, hammer them in after cutting off and discarding their heads.

Treenails are commercially available, but making your own is easy. Buy a package of long bamboo skewers, strip off short lengths, and pull through a drawplate to the desired diameter. Drill holes through the plank into the frame, dip the treenail in white or yellow glue, and drive in place. Nip the dowel flush with the planking or buy a treenail cutter. (This expensive accessory mounts in a handpiece.) For more authenticity, add treenails where each frame is on a real ship. Although time-consuming, it is visually correct.

Another alternative is to whittle flat toothpicks (round ones don't work as well) to a point. Place the entire toothpick in the hole, rap sharply with a 10-inch bastard file, and break off the remaining portion. A file works better than a hammer, because its serrated surface catches and firmly holds the head of the toothpick, permitting it to be driven in tightly. Exterior stubble is dressed and sanded smooth when treenailing is completed.

Double Planking

Most foreign and some U.S. kits are designed with a double-planked hull. The inner layer is usually basswood or other inexpensive hardwood. The outer layer is an exotic hardwood or walnut. This system has several advantages. Double planking produces a stronger hull, especially if the bulkheads are widely spaced. Beginners can practice on the first layer, then hope for perfection on the second. Practice makes perfect. However, the biggest reason for double planking is the outer planking accepts a natural wood finish, which many modelers prefer. Since the inner hull planking is covered, install it any way you choose. However, I recommend applying both layers according to the plans or shipwright planking practices. Install wales and other thicker strakes in their correct locations.

Planking the Outer Hull

The planks from the upper rail down to the bottom of the main wale have little or no fore and aft taper. These areas are easy to install. Looking at the hull side, you will probably see "bands" of planking. Perhaps a band between a topgallant and main rail, bands above and below gunports, and bands in line with gunports. Within each of these bands, the planks are generally of equal width.

Assuming the plans are correct, rails, wales, waists, and gunport bands are preset lines and can't be modified. However, some liberties with the planking layout are possible below the wale, since it doesn't affect the plan. Most planking from the bottom of the wale or waist to the keel requires tapering fore and aft. Consequently, use a proportional dividers and divide this segment of the hull into three or four belts. As an example, let's use four belts and label them **A** through **D**.

If the plans show a planking layout, lay a tick strip along each bulkhead and mark the bottom-of-wale location and the belt seams below. Transfer these points in pencil to the model. Now temporarily tack four, 1/16" x 3/32" (1.5mm x 2.5mm) basswood battens along the port and starboard belt lines. Battens assure an accurate run of planks by correcting errors in drafting, tick strip marking, or transferring. Remember, the wale line is a given and should follow the plans. If it isn't on the plan, refer to the previously-mentioned guidelines.

Once the eight battens are in place, check their flow. Look at the model from the side and from the bow and stern. Do the battens have a pleasing, smooth curve? Are they symmetrical? If necessary, adjust the lower battens until they are. When everything is fair, make sure the belt seams are clearly visible. Remark those that aren't. Now, either remove the battens or leave them in place until they interfere with installing a plank.

Tapering Plank Edges: As planking proceeds, the edges of a particular plank may require tapering to butt flush against its neighbor. Properly machined planks have square edges. Butting them together on a hull may produce small gaps. Most are sealed with glue or wood filler, or caulked on a real ship. Plank edges are often deliberately tapered to ensure they butt against each other, while providing a sufficient gap for caulking. To create a perfectly smooth hull without gaps, trim each plank edge as it is fit. Double-planked hulls usually have a much thinner outer layer, so tapered edges are less of a problem.

Planking at the Counter: A ship's design determines what configuration the planks take when they terminate at the counter. Figure 3-36 illustrates some variations.

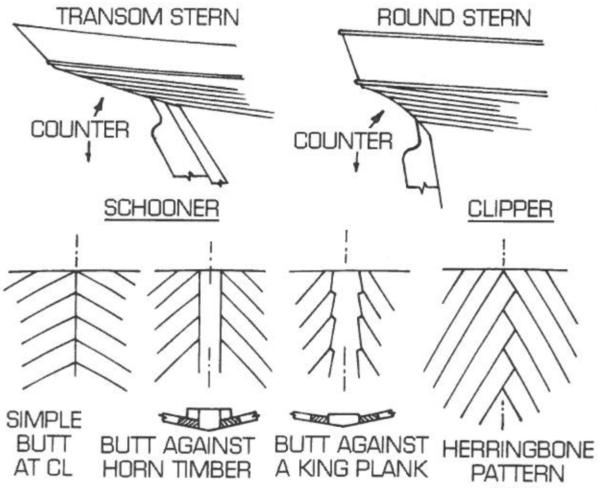


FIG. 3-36 – STERN COUNTER PLANK VARIATIONS

Planking a Main Wale: A main wale is generally thicker than the other planks. In fact, wales on some Medieval ships were composed of several different plank thicknesses and had fancy joints as in Figure 3-37. (If the plans don't show them, a little research may be in order.) However, they can taper at the

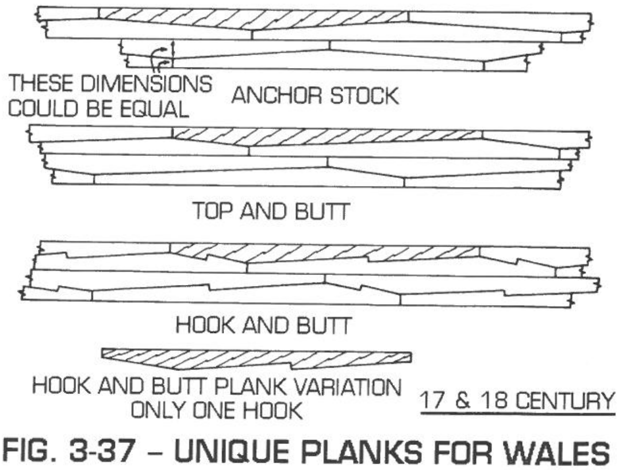

THESE DIMENSIONS COULD BE EQUAL
ANCHOR STOCK
TOP AND BUTT
HOOK AND BUTT
HOOK AND BUTT PLANK VARIATION ONLY ONE HOOK
17 & 18 CENTURY

FIG. 3-37 – UNIQUE PLANKS FOR WALES

bow and stern to the same thickness as other planks so they seat into the rabbet. Carve or sand this taper either before or after mounting the planks.

On many ships, a wale's lower edge is the same thickness as the planks beneath it. If so, install **Belt A**, then sand the lower edge of the wale flush with it. *Laying the Planks in* ***Belt A***: Because each belt is done separately, planking can start with any one. However, it's logical to begin at the top and work down. Let's assume **Belt A** has five plank strakes of equal width. Let's also assume the maximum plank width is 3/16" (5mm) at amidships and the planks taper fore and aft to 3/32" (2.5mm). Following the rule of one plank covers four bulkhead spaces, use 3/16" wide planking at amidships, then switch to 1/8" (3mm) wide fore and aft. Taper the planks with a plane.

Use a proportional dividers to divide **Belt A** into five equal plank widths. Mark their positions in pencil on each bulkhead (Figure 3-38). The next step is to cut the planks to fit between the marks. Let's assume the hull has 11 bulkheads labeled **A** through **K**. Start at **Bulkhead F**. Use four planks; one from **Bulkhead F** to **Bulkhead J**, another from **Bulkhead J** to the stern, **Bulkhead F** to **Bulkhead B**, and **Bulkhead B** to the stem.

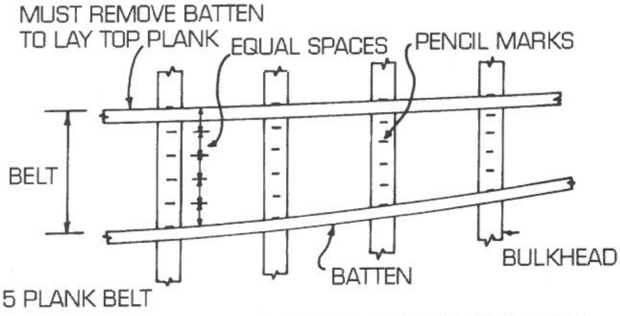


FIG. 3-38 – MARKING PLANK WIDTHS

First, lay a piece of planking stock over **Bulkhead F** to **Bulkhead J**. In pencil, mark their overall length on the plank, then the position of each bulkhead. Next, using a set of dividers or tick strip, lift the plank widths from the marks on the bulkheads and transfer to the stock. Draw a line through the points and cut the plank. Trace this tapered plank to obtain another for the other side of the hull. Repeat for the remaining planks in **Belt A**.

Install these planks. Repeat the process for the next strake, but stagger the butts. Install a plank from **Bulkhead E** to **Bulkhead A**, **Bulkhead A** to the stem, **Bulkhead E** to **Bulkhead I**, and **Bulkhead I** to the stern. You now have four planks making up each strake from bow to stern (Figure 3-39). Moving to the next planking strake, stagger the butts starting at **Bulkhead D**. Continue until this run is finished, then complete the others in **Belt A**. Steam bend the planks where they curve sharply at the counter. Once **Belt A** is planked, sand the bottom of the main wale flush with the planking if this is required on your particular model.

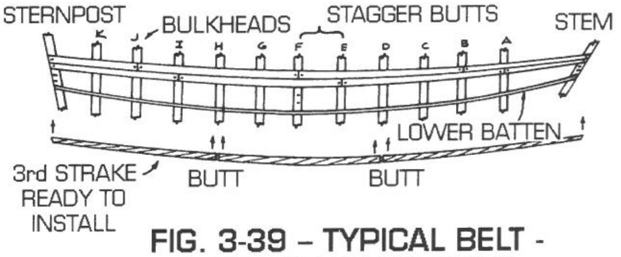


FIG. 3-39 – TYPICAL BELT - 2 COMPLETE STRAKES

Laying the Planking in ***Belt B*** *and* ***C***: These belts are similar to **Belt A**. However, the planks may widen at the stern rather than taper. It depends on the hull. If the temporary batten is still in place, remove it. Lay the planks for **Belts B** and **C**, but remember to stagger the butts.

Laying the Planking in ***Belt D***: This belt contains the garboard strake (next to the keel). Planks in this belt are wider at the stern and may require stealers.

Plank Variations within a Belt: Suppose a belt has nine planks, but the eighth plank must be wider to complete the belt. Cause for worry? Certainly not. No planking job, even on real ships, is that precise. After all, these are hand-cut planks and slight variances do occur, so be realistic. The important thing is to keep their flow smooth.

Figure 3-40 shows Robert Steinbrunn's model of Model Shipways' *Fair American*. His planking job is first rate. Notice how the natural finish below the wales highlights his craftsmanship.

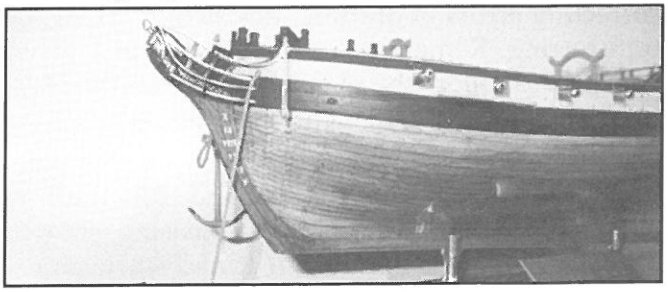


FIG. 3-40 – FAIR AMERICAN - MODEL & PHOTO BY ROBERT N. STEINBRUNN

Scuppers and Freeing Ports

Scuppers (Figure 3-41) are interesting details and should be included on your model. Some are simply holes passing through the waterway and out the

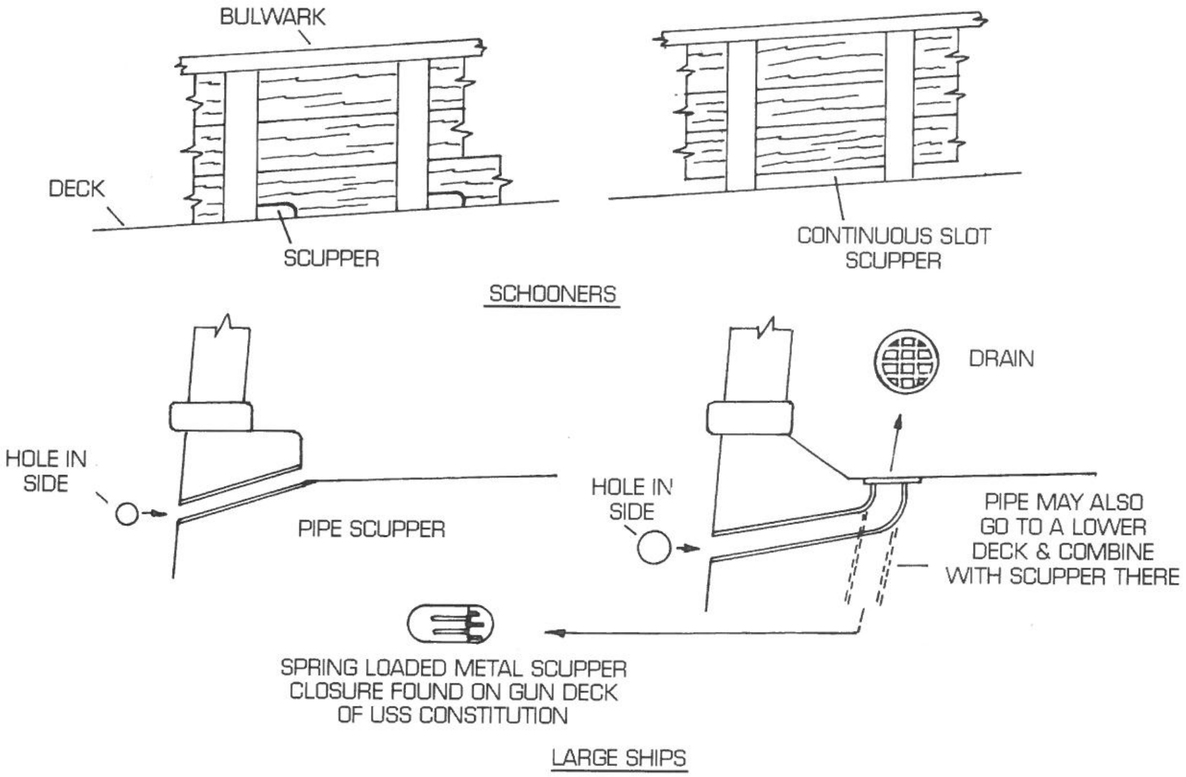

BULWARK
DECK
SCUPPER
CONTINUOUS SLOT SCUPPER
SCHOONERS
HOLE IN SIDE
PIPE SCUPPER
HOLE IN SIDE
DRAIN
PIPE MAY ALSO GO TO A LOWER DECK & COMBINE WITH SCUPPER THERE
SPRING LOADED METAL SCUPPER CLOSURE FOUND ON GUN DECK OF USS CONSTITUTION
LARGE SHIPS

FIG. 3-41 – SCUPPERS

side of the hull. Scuppers aboard schooners were either a series of slots at each timberhead or a continuous slot at the base of the bulwark. To duplicate scuppers on a solid hull model with carved bulwarks, drill two holes for each drain and remove the wood between them. For a planked model, cut the scuppers in the plank before installing it. Figure 3-42 shows a freeing port on a clipper ship.

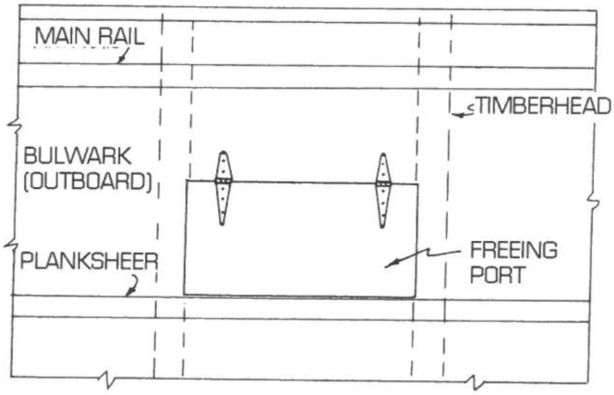

MAIN RAIL
TIMBERHEAD
BULWARK (OUTBOARD)
PLANKSHEER
FREEING PORT

FIG. 3-42 – TYPICAL FREEING PORT

Planking a Solid Hull

Most p-o-b rules apply when planking a solid hull. However, because there are no bulkheads, butt restrictions aren't applicable. Nevertheless, it's important to maintain scale plank lengths and stagger the butts for authenticity.

PLANKING THE DECKS

Hatch and Companionway Coamings

Before planking the deck, decide how to treat the coamings. For that shipshape look, install the coamings first, then plank around them. This is not only how shipwrights did it, but it saves some work and material. However, planks need a permanent landing around coamings and kits rarely supply deck beams for this. Depending on the kit's design, one solution is to glue and pin 1/8″ (3mm) thick scrap wood underneath each coaming prior to installation (Figure 3-43). Other kits support the coamings and planking with a plywood sub-deck.

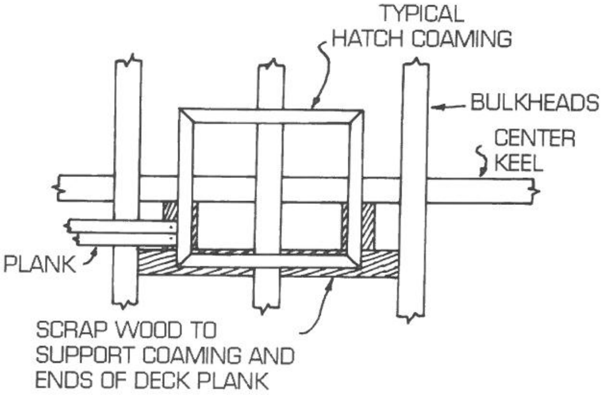
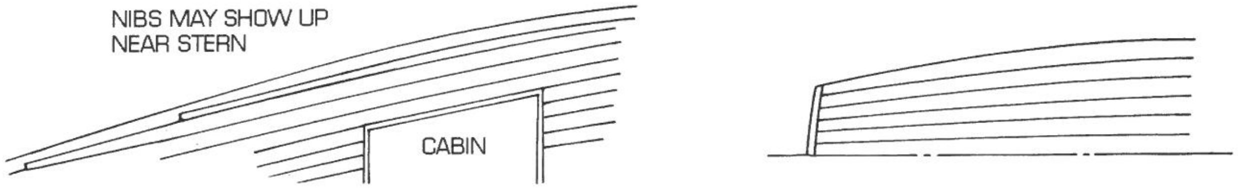
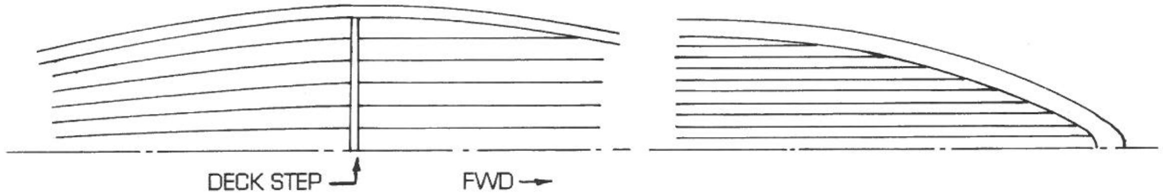

TYPICAL HATCH COAMING
BULKHEADS
CENTER KEEL
PLANK
SCRAP WOOD TO SUPPORT COAMING AND ENDS OF DECK PLANK

FIG. 3-43 – SUPPORTS UNDER COAMINGS



PLANKS PARALLEL TO CABIN TRUNK
TYPICAL FOR FISHING SCHOONER

PLANKS TAPERING TOWARD STERN
(OR BOW)



AFT PLANKS TAPER TOWARD STERN
OR FOLLOW CABIN TRUNK - FORWARD
PLANKS PARALLEL TO CENTERLINE

ALL PLANKS PARALLEL TO CENTERLINE

FIG. 3-44 – DECK PLANK VARIATIONS

Deck Planks

Since most decks are unpainted, your workmanship is highly visible. A first-rate deck has a snappy, clean look. Essential elements such as thick planks around masts and pads under a capstan or windlass weren't forgotten. Some craft had a kingplank, a thicker strake running along the centerline. While plans don't always show these details, they are vital to maintaining historical accuracy. Therefore, review plans of similar vessels or consult books to learn what could be missing on your set.

Hopefully, they depict the correct run of planking for that particular ship. Some vessels had a simple layout with all planks parallel to the centerline. For others, the planks tapered fore and aft, or just aft. Some planks followed the curve of the bulwark; others the angle of a cabin (Figure 3-44 and Figure 3-45). Deck planking widths changed as naval architecture evolved. Planks were often wider on ships built before the 19th and 20th centuries. From the 1800s forward, 3" to 6" (76mm to 152mm) wide deck planks were common. If your plans show widths outside the norm, consider changing them.

Prepare the planks by painting one edge black or dark brown to simulate deck caulking. Be careful! Too much paint will penetrate too deeply with unsightly results. Do a test first. If it doesn't work, edge glue the planks with brown woodworker's glue. This adhesive dries dark enough to replicate caulking.

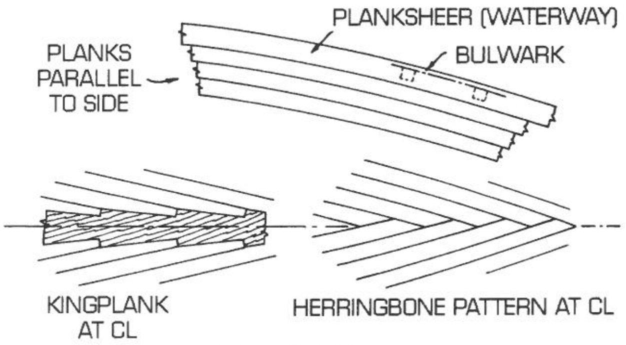


FIG. 3-45 –
DECK PLANKS PARALLEL TO SIDE

Procedure: Start planking the deck at the centerline and work outboard. Scrape off any glue that squeezes out before adding the next plank. Planking butts are optional, because they don't show up as readily as the caulked seams. If desired, fasten planks with brads or treenails, but keep their diameters small. From a distance, they are hardly noticeable.

Nibbing: Some deck planks nibbed into a margin plank. Nibbed joints must fit tightly and cleanly; otherwise, they are unsightly. Figure 3-46 shows nibbing near the bow.

Clippers and other large ships had a thick continuous binding strake along the waterway, then a few strakes before the margin plank. Although a little more work, don't overlook this interesting deck detail.

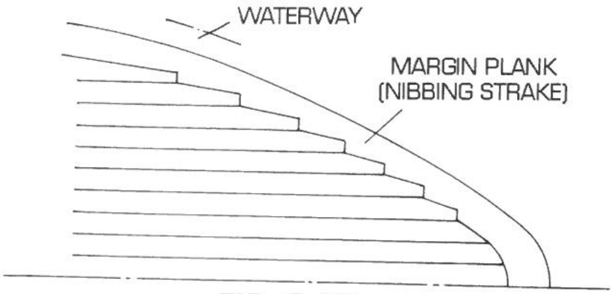


FIG. 3-46 –
NIBBING DECK PLANKS AT BOW

Finishing: Once the deck is installed, apply a stain such as Minwax or flat varnish to protect it. When painting other hull areas, it's amazing how a few specks always land on the deck. Splatters remove more easily if the deck is finished. Even so, tape paper over it until the other work is completed, because many models are spoiled as work progresses. It's a shame to do a good job, then mess it up.

COPPER SHEATHING

While coppering a hull seems a difficult task, it is fairly easy. Like almost everything in shipmodeling, it just takes a little time and patience. The biggest headache is drawing the plate lines on the hull. If your plans don't show a plating layout, consult Appendix A for references and seek some advise on plate arrangements. The complete scheme must be laid out before starting to copper.

Most layouts show belts with the plates almost parallel to each other. However, belts can overlap other belts or have *gore ends* (plate ends go under others). Belts sometimes fan out at the lower stern and a filler plate may be necessary. (Actually, it's just another form of gore end on the belt below.)

Some kits supply self-adhesive copper tape. Although using long strips and scribing in fake butt laps is possible, if the strips are too long, they won't follow the hull's curves. For a first-rate sheathing job, cut the tape into individual scale plates and overlap them like on the real ship. Adhering to shipwright practice looks best and is authentic. If your kit has individual plates with out-of-scale dimples representing nailheads, get rid of them.

Begin by marking the belt seams in pencil onto the hull. Follow the layout shown on the plans or the one you developed. Invert the model, then start coppering at the keel and stern. Looking at it upside down, forward plates overlap aft ones, and lower plates overlap upper ones (Figure 3-47). Position the plates *precisely* on the pencil lines to keep the seams straight. If they are wavy, the effect is awful.

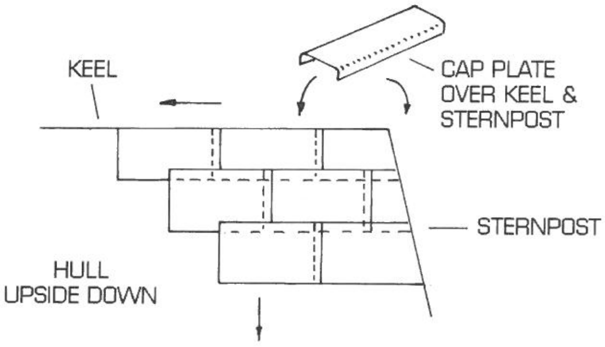


FIG. 3-47 – INSTALLING COPPER PLATES

Copper plates aren't tapered like the hull planking, so some strakes cross others. While a gore end can pass under the covering strake, its square corners might show through the thin copper. Consequently, trim the ends of the gore strakes so they just slip beneath the upper strakes (Figure 3-48).

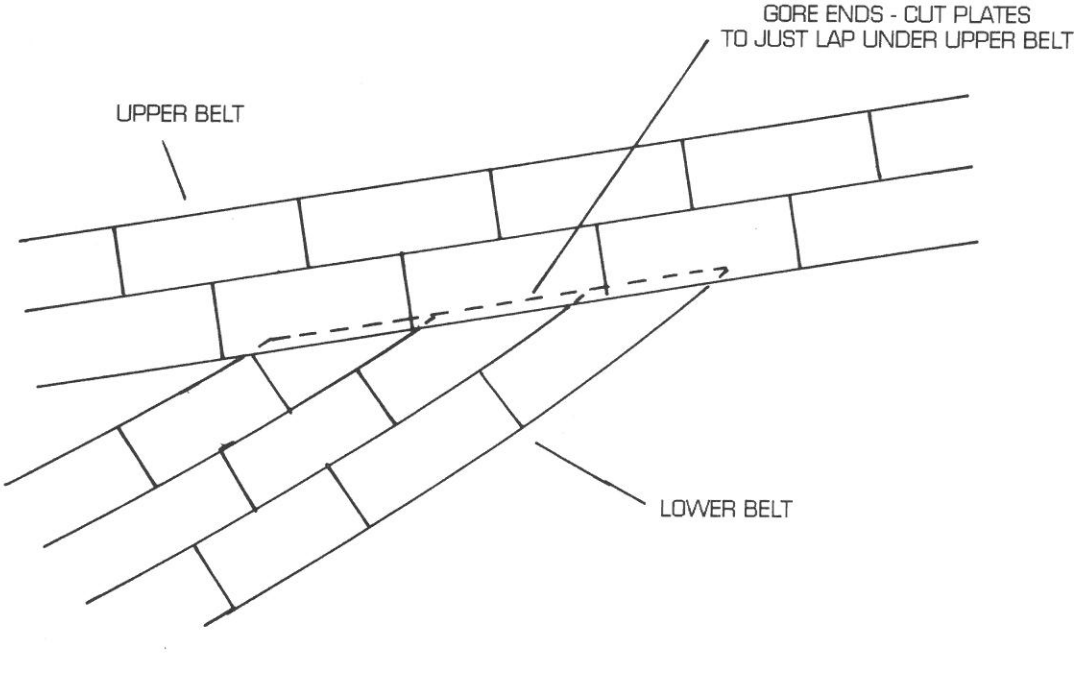


FIG. 3-48 – GORE ENDS OF COPPER SHEATHING

Plate the rudder before installing the pintles.

Nailing: Some modelers like to simulate the nailheads in sheathing by indenting the copper with a sharp point (Figure 3-49). However, if the scale is 1/4" (1:48) or smaller, forget it, because any attempt will probably ruin the coppered effect. From a distance, nail heads are almost invisible on a real ship.

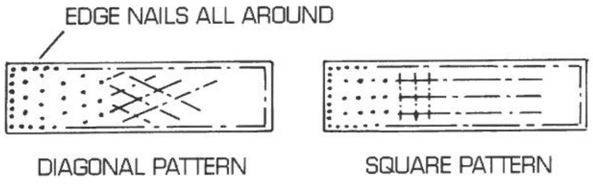


FIG. 3-49 – TYPICAL COPPER PLATE NAIL PATTERNS

Coloring: Plates will corrode naturally or can be chemically weathered using Patina-It (brand name), which turns them bluish green. Another solution, Sal Ammoniac and vinegar, also turns copper green, but creates more salt buildup. One school of thought believes salt water washes away copper sulfate when the ship is underway. Patina forms only if the vessel is in dry dock for a long time. The choice is yours, but I believe patina gives the model a salty look. Furthermore, if the model is mounted on pedestals, any copper exposed to air will automatically develop this sheen.

PLANK-ON-FRAME CONSTRUCTION

At this time, only Model Shipways' *Emma C. Berry* and BlueJacket's *America* and *Jefferson Davis* are true p-o-f kits. The Lumberyard's laser-cut frames for Harold Hahn's colonial schooner designs are the next closest thing, but they don't qualify as a kit.

The primary differences between a plank-on-bulkhead and plank-on-frame model are: the latter has more frames, keel and stem construction are refined, and deck beams are laid. Hull planking is about the same, except more butts may be necessary.

One advantage to a p-o-f hull is leaving it, or portions of it, unplanked to reveal the framing. This presentation appeals to viewers. Figure 3-50 shows John Fryant's *Emma C. Berry* model. He did a first-rate job. Note how omitting some planks enhances the boatyard diorama.

Setting up and maintaining symmetrical frames are the most critical elements when building a p-o-f model. Constantly check frame spacings, heights to the sheer line, and the angles of each frame so they align properly. Use a batten along the frames to help position them, and another one on top of the bulwarks to assure the correct sheer. Fryant beveled *Berry's* laser-cut frames, but those in BlueJacket's kits are prebeveled. Once all the frames are up, use a sanding block to smooth the transitions from one to another.

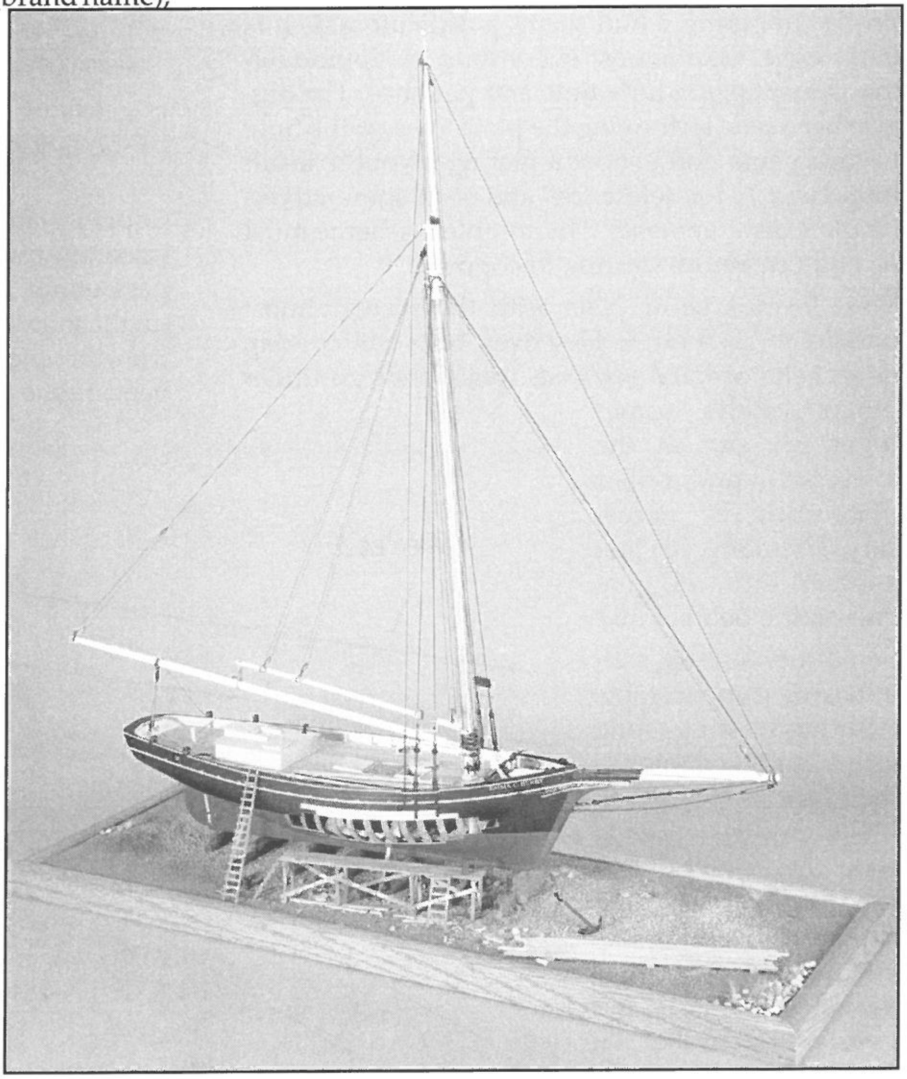


FIG. 3-50 – EMMA C. BERRY
MODEL BY JOHN FRYANT. PHOTO BY MODEL SHIPWAYS, INC.

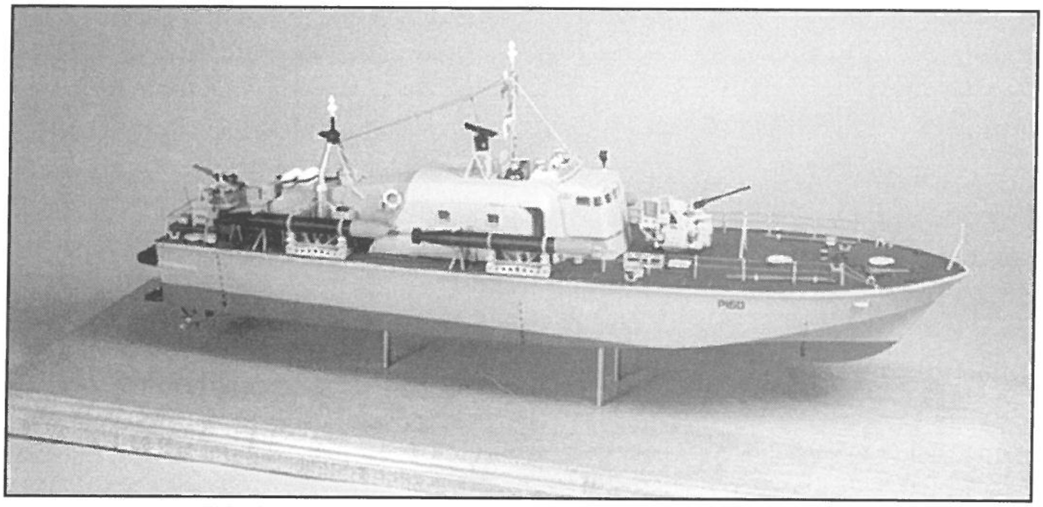


FIG. 3-51 - TAMIYA VOSPER PT BOAT PLASTIC KIT

PLASTIC KITS

Plastic ship models vary in design and molding. Some feature reasonably accurate scale parts, while others are grossly overscale. Furthermore, most kits don't have a set of scale plans. Consequently, research its historical accuracy and the scale of various parts. A little effort can produce a respectable model.

Hull Assembly

Fill joints where hull sections meet with a plastic filler such as Squadron Green Stuff or White Stuff. Sometimes one piece is warped slightly at the seam. Be sure to fill in the depression as well. Generally, plastic hulls come in halves, so the only seam to worry about now is the one along the keel, stem, and stern.

Wood Grain and Other Embossed Features

Some manufacturers go overboard and mold in wood grain, plates, planking, and coppering. Doing so makes the hull look worse, because these areas are often out of scale or the pattern is too uniform. If possible, sand or fill them to look more scalelike.

Railings and Other Small Details

Some railings are molded as part of the hull and are generally out of scale. This is especially true of older reissued, but not upgraded, kits. If the manufacturer didn't use more up-to-date techniques, simply cut off the railing, model new stanchions from brass or plastic, and use wire or thread for the rails. Or, depending on the model and scale, purchase and install photoetched parts. More and more are coming onto the market.

Prepainted Hulls

Some modern warship hulls are gray styrene above the waterline and red below it. This is a shortcut and unacceptable for our purpose. A first-rate model has genuine paint on it. Therefore, sand the waterline smooth to remove the paint edge, prime the entire hull, sand lightly again, then apply the cover coat.

Figure 3-51 is Tamiya's *Vosper PT*. This is a quality kit, and the only modification required was removing its prepainted bottom. I painted the hull using an airbrush.

Incomplete Molding

Kit designers decide what details are and aren't molded into the parts. For example, Revell's submarine, *USS Lionfish*, has molded flood holes forward, but not in the superstructure where they are embossed outlines. The instructions say to paint these black. However, the model will look more convincing if you ream out the holes. It may take a while, but the effort is worth it.

Copper Sheathing

Hulls with heavily embossed copper sheathing are best painted. Use a uniform color or, for more realism, brush streaks of green and blue into the base coat to suggest patina. Practice off the model until you achieve the desired effect. If the embossed lines are faint, consider applying self-adhesive copper foil "plates." These add to the model's overall appearance and are more realistic. Another option is to purchase Pure Gold or Rub 'n Buff copper (also called autumn gold) or patina metallic finishes in a tube. Their wax-based formulas produce a lustrous, mellow sheen no paint can duplicate.

CHAPTER 4
DECK STRUCTURES, SHIP'S BOATS, AND FITTINGS

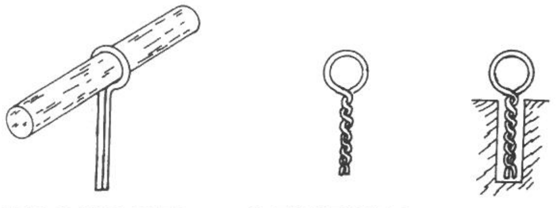
Although this chapter is concerned primarily with sailing ships, most modeling techniques apply to other types of vessels as well.

Once the basic hull is completed, lightly mark in pencil the positions of hatches, companionways, fife rails, belfries, pin rails, boat davits, galley stacks, bowsprit bitts, stern bitts, capstans, windlass, and catheads. Measure from a known benchmark such as the centerline or the center of a mast. If your research proves the kit's general arrangement drawing is wrong, don't hesitate to change an item's location or even the item.

Install eyebolts and cleats now, so they'll be ready when rigging commences. Unfortunately, many deck and bulwark drawings don't show where to mount them. If so, determine their positions from the rigging plans. Some will be indicated, but you'll have to locate others based on the general rigging scheme. Mark these locations on the deck plan for reference. Now drill a hole in the deck or wherever for each eyebolt. Using a toothpick or Microbrush, spread a thin film of cyano on the bolt, then insert. Don't overdo the glue. When all are mounted, tug on them to test the bond.

Most kit eyebolts are simply a brass wire bent into an open loop. To close it, touch with a little solder or epoxy. However, making perfect scale eyebolts is easy (Figure 4-1). Bend the wire around a drill bit or metal rod of the proper diameter. Clamp the rod in a vise, slip a wire "U" over it, grasp the ends with pliers, pull back slightly, and twist. A spiral shank traps glue and ensures a permanent bond. This eyebolt won't come adrift.

Glue and pin the cleats. Use two pins on large ones so tensioning the rigging won't pull them out.



1. FORM WIRE OVER DRILL BIT OR ROD

2. TWIST WITH PLIERS

3. GLUE IN HOLE

FIG. 4-1 – MAKING EYEBOLTS

SCALE

Scale is of the utmost importance when modeling deck structures and fittings. Over- or undersized parts have ruined many models. Keep a scale or caliper handy to check all supplied fittings against the plans to see if they are truly to scale. Replace or modify any incorrect item. Think full size as you work. A sailor's average height was 5'8". If the model's capstan bars are a scale 5'6" from the deck, the fitting is too tall and probably overscale.

PAINTING

Painting structures and fittings off the model is easier and faster, because little masking or covering is required. You also do a better job. Therefore, think about painting before installing an item. Heat fittings, paint, and your workroom to 70°F (21°C) for the best results. If masking is required, stick the tape to a pane of clean glass first to remove excess tackiness, or use a low-tack tape. After applying it, burnish hard, being particularly aggressive along the edges.

Be careful not to paint any areas destined to receive glue. If using an airbrush, apply a mist coat first. This prevents the paint from leeching through the masking tape, while gradually building up the paint's thickness. Allow each coat to dry fully before spraying on the next. Sometimes eight or nine light applications are required before an adequate covering is achieved, especially if you're using acrylics.

Examine every mist coat and rub down as necessary with 600 or 800 wet-and-dry grit used wet. Work with a sanding block where applicable. Never remove the masking tape until the finished coat has dried for 24 hours in a 70°F room. After installation, check each piece and touch up the paintwork where needed with a brush.

DECK FURNITURE

Some kits supply wood strips to scratch build cabin trunks, hatches, and companionways, while others include only basswood blocks. If the blocks aren't precut to the exact size, saw them to the required dimensions shown on the plan view. Check 90° corners with a machinist's square. If the structure is tapered, such as the aft cabin on a schooner, check the corners with a protractor to make sure both

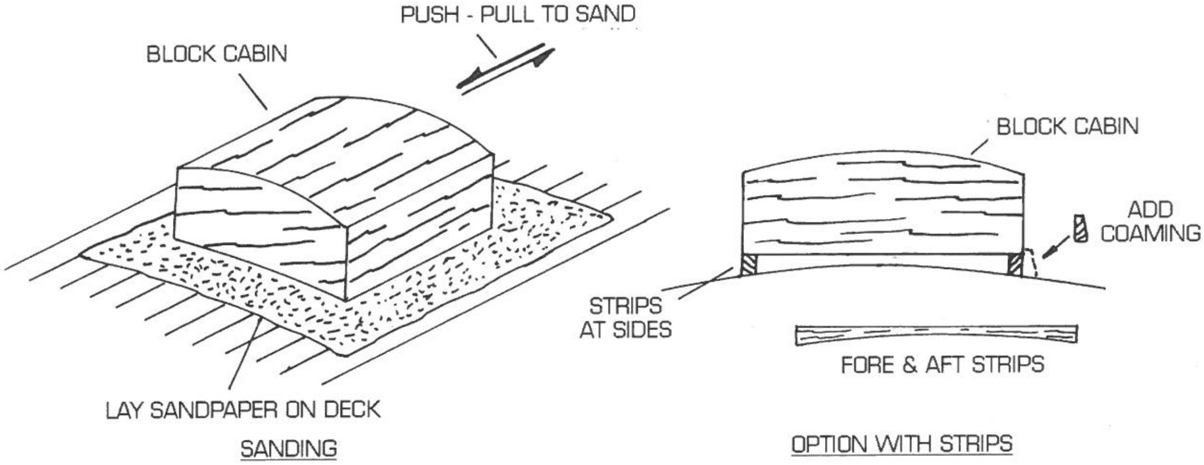

PUSH - PULL TO SAND
BLOCK CABIN
LAY SANDPAPER ON DECK
SANDING
BLOCK CABIN
ADD COAMING
STRIPS AT SIDES
FORE & AFT STRIPS
OPTION WITH STRIPS

FIG. 4-2 – ADDING CAMBER TO BLOCK STRUCTURES

sides are identical. Once the plan shape is correct, carve and file the roof. It may be flat or have camber. Sand the bottom of the structure to match the deck's camber. Simply lay a piece of sandpaper on the deck, then push the block forward and aft until it seats flush. Option: Add small strips on the bottom edges of a structure if you don't want to sand in the camber (Figure 4-2).

A block's biggest problem is its unsightly end grain. Fill it with wood filler, then smooth with a sanding block taking care not to round any square edges. If bits of end grain still protrude, repeat the process. Another solution is to cut 1/16" (1.5mm) off the end grain, then glue on a 1/16" thick basswood or plywood sheet.

Windows and Airports: Drill holes for airports and cut window openings at least 1/8" (3mm) deep. Remember, ship windows were not always square. Depending upon their locations, top and bottom sills may follow sheer lines or deck cambers. Rarely were two window openings identical. Penetrations should appear as if they have depth, so paint them flat black to enhance the illusion. For added realism, insert plastic sheet or microscope slide covers for openings larger than one-quarter inch square. For window panes less than one-quarter inch square, use Micro Glaze, a liquid glazing compound available from Micro-Mark and most hobby shops.

Mouldings: If coamings were installed on the deck, cut the sides of the block to fit inside them, or sit the block on top of the coaming. If not, glue and pin wood strips to the block at deck level to simulate coamings. Roofs are finished in two ways; either add moulding strips, or glue on planks or a solid sheet that overhangs the required amount. If the latter, compensate for the thickness of the roofing material when first shaping the block (Figure 4-3).

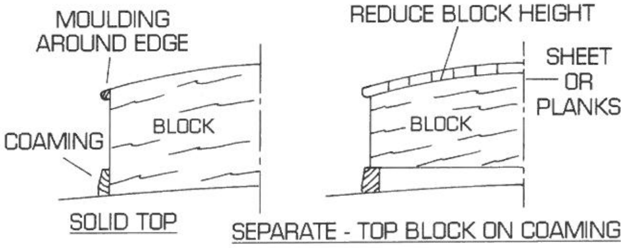

MOULDING AROUND EDGE
COAMING
BLOCK
SOLID TOP
REDUCE BLOCK HEIGHT
SHEET OR PLANKS
BLOCK
SEPARATE - TOP BLOCK ON COAMING

FIG. 4-3 – DECK STRUCTURE TOPS

Moulding Details: Most ships had mouldings around the upper edges of cabins, companionways, and other structures. First-rate models should have them, too. Follow the plans if they show milling details; otherwise, search photos and books for typical moulding patterns (Figure 4-4).

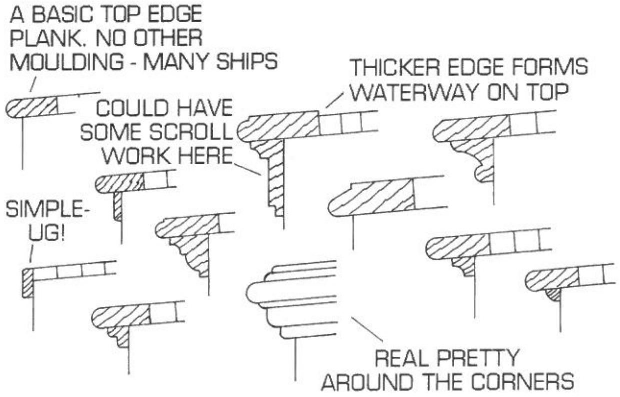

A BASIC TOP EDGE PLANK. NO OTHER MOULDING - MANY SHIPS
COULD HAVE SOME SCROLL WORK HERE
THICKER EDGE FORMS WATERWAY ON TOP
SIMPLE-UG!
REAL PRETTY AROUND THE CORNERS

FIG. 4-4 – SOME DECK STRUCTURE MOULDINGS

Making Mouldings: Kits usually don't include precut mouldings, so either purchase dollhouse mouldings or mill your own. A hand scraper or single-edge razor makes an ideal tool. Use jeweler's files to cut the pattern into the metal. Clamp a plank the

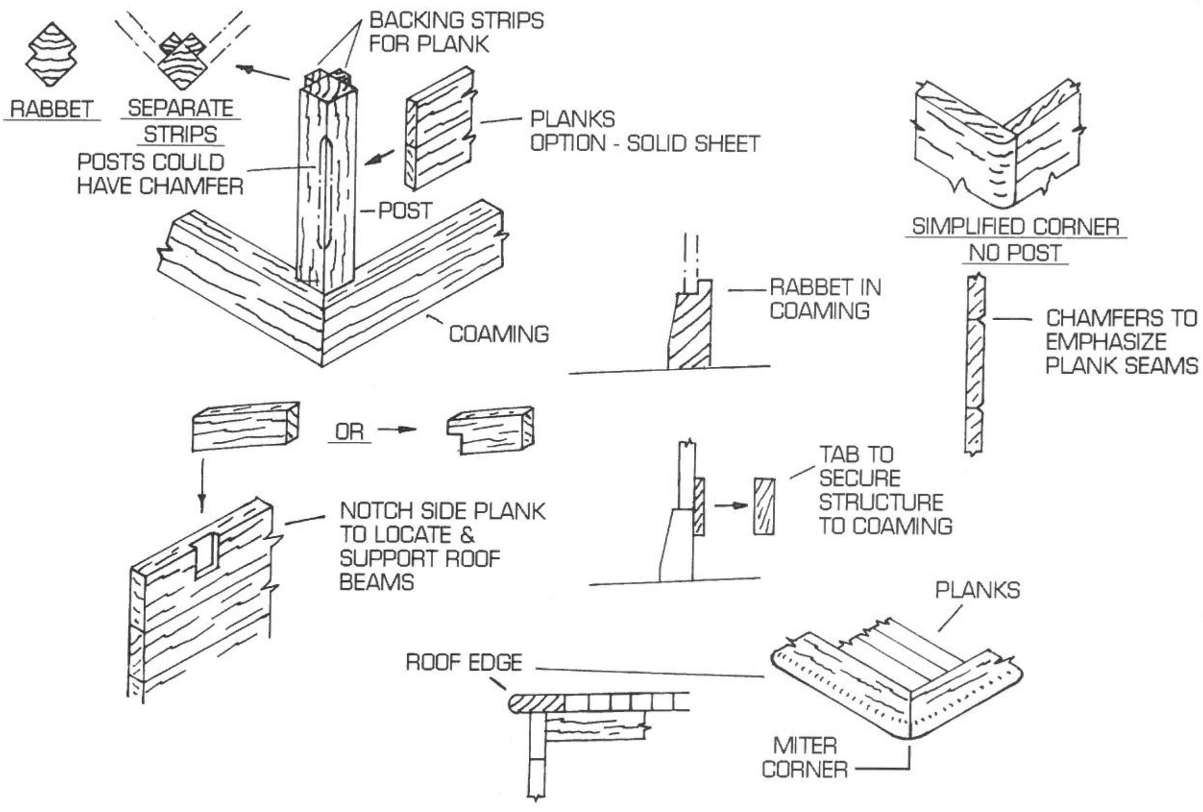

BACKING STRIPS FOR PLANK
RABBET
SEPARATE STRIPS
POSTS COULD HAVE CHAMFER
PLANKS OPTION - SOLID SHEET
POST
COAMING
SIMPLIFIED CORNER NO POST
RABBET IN COAMING
CHAMFERS TO EMPHASIZE PLANK SEAMS
OR
NOTCH SIDE PLANK TO LOCATE & SUPPORT ROOF BEAMS
TAB TO SECURE STRUCTURE TO COAMING
PLANKS
ROOF EDGE
MITER CORNER

FIG. 4-5 – DECK STRUCTURE CONSTRUCTION DETAILS

required thickness in a vise. Place a drop of antique, tung, or teak oil (not varnish or cellulose) on a fingertip and rub it along the edge to be moulded. Dry wood doesn't like being scraped, but a light film of oil softens its mood. With both hands on the cutter for control, place it on the strip and draw it smoothly toward you using light pressure at first. Repeat the stroke with more and more force as each new cut begins. As soon as the tool gives any indication of grabbing, resharpen with a fine file on the flat side. Keep the oil coming on the cutter and wood. This polishes the moulding as it's worked. When finished, cut to size, then pin and glue it with woodworker's adhesive.

Another alternative is to purchase Dremel's small router bits for milling mouldings.

Stripwood Structures

Built-up deckhouses and cabins are more realistic and fun to model. Feel free to ignore the wood blocks in your kit and fashion these structures from stripwood. Most kits contain enough extra wood to do this. Generally, plank-on-bulkhead and plank-on-frame kits are designed with built-up structures. Figure 4-5 illustrates some construction details.

Coamings

Deck structures are built on coamings. As noted previously, the first-rate approach is to fit a coaming before planking around it. Attaching coamings to deckhouses and cabins, then gluing them to the deck invites problems, especially if the run of planking at the coaming doesn't follow shipwright practice. Also, the structure may not sit flush on the deck, producing unsightly gaps.

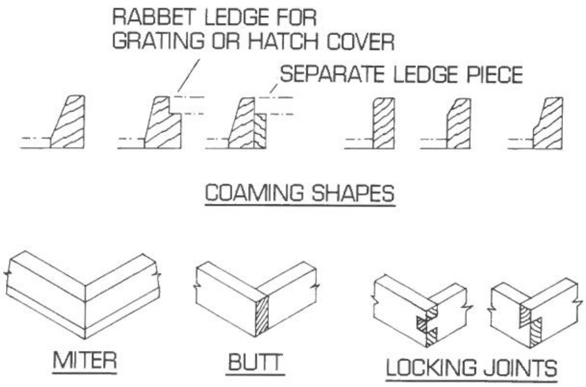

RABBET LEDGE FOR GRATING OR HATCH COVER
SEPARATE LEDGE PIECE
COAMING SHAPES
MITER
BUTT
LOCKING JOINTS

FIG. 4-6 – SOME COAMING SHAPES & JOINTS

If the plans are well executed, they will show the coaming's shape and how the corners are joined. If not, do a little research to discover these details

(Figure 4-6 shows several examples). Gratings or hatch covers fit on a ledge inside the coaming. Determine their depth, then cut the ledges into the coamings or add a separate piece inside the coamings. Some modelers prefer assembling hatch covers and gratings first, so they know exactly how much stock to remove from each coaming.

Companionways

Companionways (Figure 4-7) are interesting structures to build, but exercise care to ensure scale detail. The sliding cover, cover rails, and mouldings are generally made from thin stock (1" to 2" full scale thickness), and it's easy to select the wrong material or not have the proper thickness in the kit. If so, sand or plane the stock to scale.

Hatch Covers and Gratings

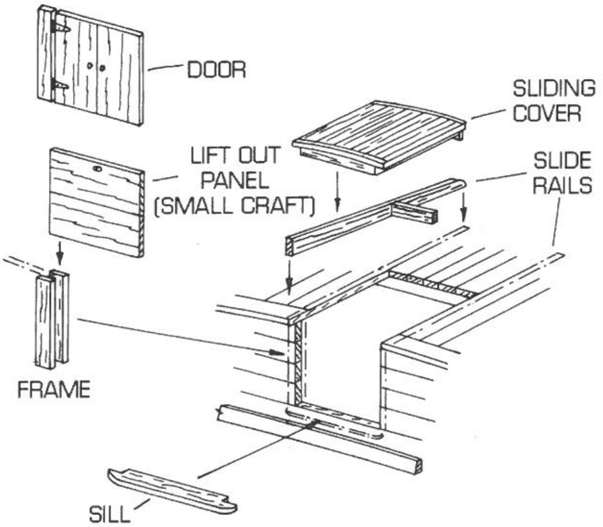


FIG. 4-7 - A TYPICAL COMPANIONWAY

Covers sealed hatches during inclement weather, while gratings allowed light and air below decks on pleasant days. Some kits have preassembled gratings, while others supply strips to scratch build them. Again, keep scale in mind. Grating holes were normally 2" to 2-1/2" (51mm to 64mm) square, or 1/32" (0.8mm) square on a 3/16" (1:64) scale model. If the kit grating or strips don't come close to this, think about replacing the fitting or sanding the strips to the proper thickness.

Hatch covers were laid up of planks joined together. Most had a pair of diagonal lift rings. The kit's split rings or eyebolts are often too large and should be discarded. Buy smaller ones or make your own. When making small fittings such as these, always think scale. How big is it on the real ship? Many errors can be corrected by keeping scale in mind as you work.

Some kits have cast hatches with lift rings on the covers. They don't look realistic. Grind them off and twist up new brass rings. Other cast hatches have gratings with oversize holes (Figure 4-8). Replace those with ones built from wood.

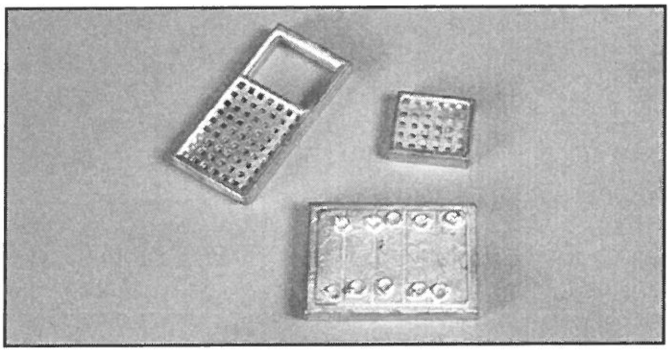


FIG. 4-8 - CAST HATCHES

SHIP'S BOATS

Ship's boats come as castings, machine-carved wooden hulls, or lifts for bread-and-butter construction (Figure 4-9). Regardless of what's in the kit, it's the end result that's important. Boat hulls should be as close to scale as possible. Wooden ones will probably need some carving. Carving a small boat hull is difficult, because it must be paper thin and of uniform thickness. One way to check its thickness is with a model-size, double-ended proportional caliper (Figure 4-10). This quality tool is manufactured by Veritas in Canada, but is available in the U.S. Set the pin in the 1-to-1 ratio hole so the

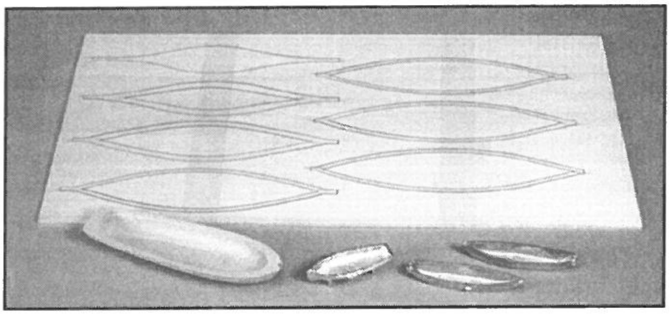


FIG. 4-9 - LASER-CUT, MACHINE CARVED, AND METAL CAST SHIP'S BOATS

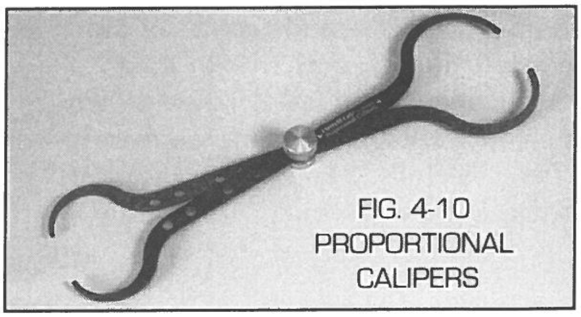


FIG. 4-10 PROPORTIONAL CALIPERS

gap at both ends of the caliper is identical. When measuring a hull's thickness, check the gap at the opposite end to see how much material remains.

Like all carving exercises, work slowly and remove a little stock at a time. Keep chisels and gouges razor sharp. Check the hull frequently with the proportional calipers. If it isn't coming out uniformly, at least carve it to scale at the gunwale to maintain the rail's correct width. The extra thickness in the bottom won't be as noticeable (Figure 4-11). Once the hull is carved, add frames, bottom boards, thwart knees, thwarts, mouldings, and any other details shown on the plans. These might be difficult to make, but don't be afraid to try. Just keep the scale in mind.

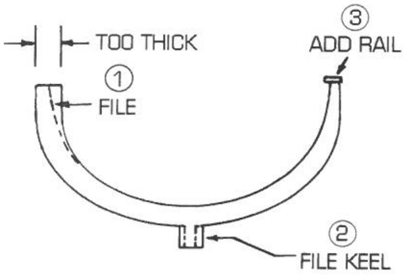


FIG. 4-11 –
SCALE BOAT GUNWALE

Since the aim of this book is to utilize as many kit parts as possible, I haven't recommended building boats from scratch. However, this is an option. Fabricate a male mold, bend frames over it, then plank the boat like a real one. Bob Steinbrunn's ship's boat from *Fair American* shows what can be achieved with patience and attention to scale (Figure 4-12). Gratings, floor boards, and frames all give it that quality touch. Don't ignore them.

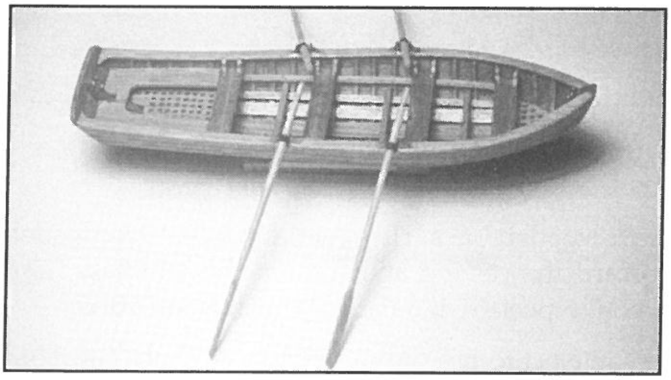


FIG. 4-12 – SHIP'S BOAT - FAIR AMERICAN

MODEL & PHOTO BY ROBERT N. STEINBRUNN

FITTINGS

Kit fittings come as britannia or brass castings, machined brass, photoetched brass or copper, and laser or die-cut wood. Most are well done these days, but because of manufacturing restrictions, many need refining to reflect the correct scale. Furthermore, some don't have the necessary details to make them look realistic. The following paragraphs address how to improve them.

Anchors and Catheads

Except for kedge anchors, most sailing ship anchors had wood stocks. Kit castings, however, generally have metal ones. A simple modification is to substitute a wooden stock, especially if it was varnished and not painted. If the shank is britannia or brass, use a chemical such as Blacken-It instead of paint. Brass and pewter blackening chemicals are readily available, and also work well for blackening bright brass chain.

The plans may not show all the details on a cathead. For example, it could have an anchor release. Do some research to find out what is appropriate for your model and add those details. Figure 4-13 shows some anchor trippers I found while researching clipper ships.

Bilge Pumps

Many kits have cast bilge pumps. Iron ones didn't come into existence until the late 19th century. Before then, they were made of wood. Consider discarding the supplied fitting and modeling a wooden one, especially if using natural finishes on the model.

Cannon and Swivel Guns

Some ship's guns are supplied as bronze-plated turnings or castings, but most are untreated brass, britannia, or white metal. Real guns were either black iron or bronze, never shiny brass or the color of britannia. Therefore, use a blackening chemical rather than paint to color brass and britannia castings. A few dips in the solution produces a bronze hue, while more submersions advance the color to black. Work with chemicals and metals at room temperature. Before treating a surface, remove scale and oxides with any liquid silverware cleaner. To avoid handling the parts, string them on enameled wire. Now they can be dipped and rinsed without contaminating the cleaned surface.

Never drop a fitting into the chemical and ignore it for an hour. Blackening a fitting in a single shot is one reason the oxidation flakes off. A dirty surface is the other. Submerge it for five seconds, then rinse in fresh water to stop further chemical action. Touch the part to a piece of paper towel to remove excess water, then hang it up to dry for 24 hours. This gives

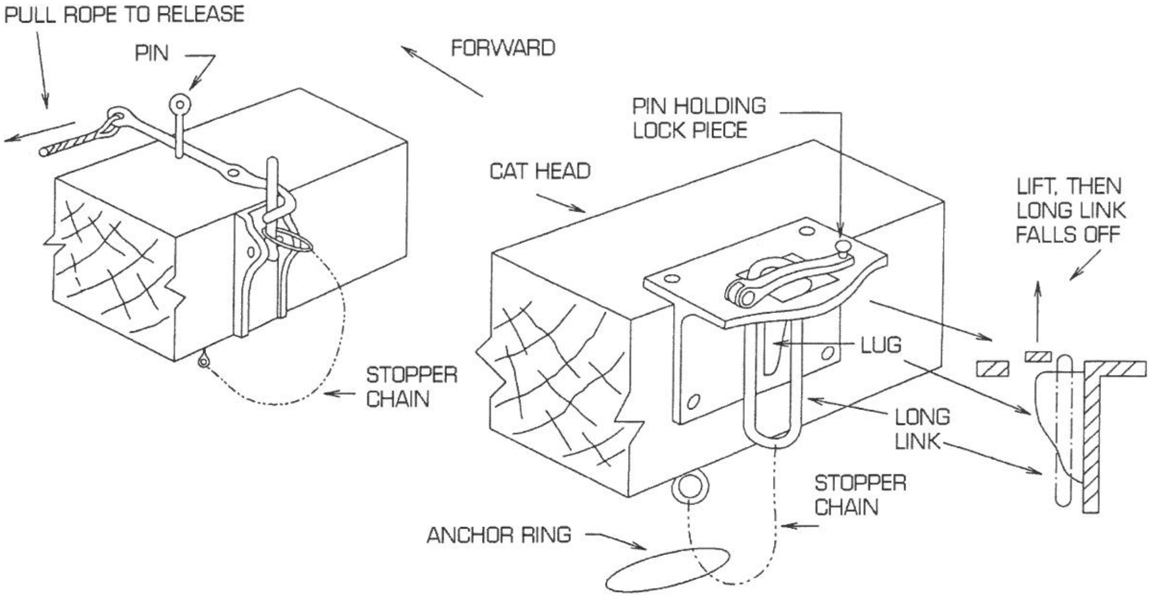

PULL ROPE TO RELEASE
PIN
FORWARD
PIN HOLDING
LOCK PIECE
CAT HEAD
LIFT, THEN
LONG LINK
FALLS OFF
LUG
STOPPER
CHAIN
LONG
LINK
STOPPER
CHAIN
ANCHOR RING

FIG. 4-13 – ANCHOR TRIPPERS

the oxide coating a chance to harden. Use fresh solution for each session. Pour the required amount into a clean container. Kodak 35mm film canisters work well for dipping small parts.

Scale is important when assembling gun carriages and rigging the cannon. Keep breech rings, trunnion caps, and gun tackle to exact scale. Cannon are closely spaced, so out-of-scale items have a cumulative effect, resulting in a bulky-looking deck.

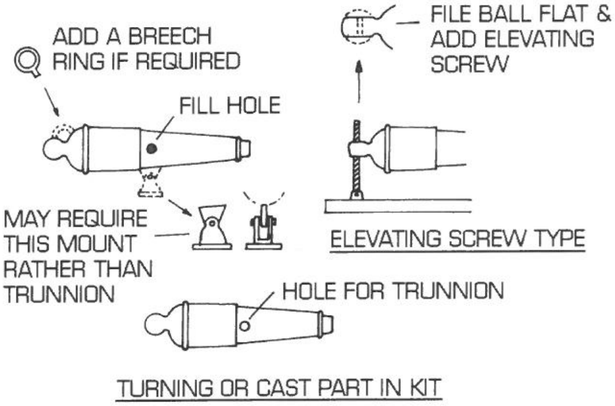

ADD A BREECH
RING IF REQUIRED
FILL HOLE
FILE BALL FLAT &
ADD ELEVATING
SCREW
MAY REQUIRE
THIS MOUNT
RATHER THAN
TRUNNION
ELEVATING SCREW TYPE
HOLE FOR TRUNNION
TURNING OR CAST PART IN KIT

**FIG. 4-14 –
MODIFYING A KIT CARRONADE**

If a carronade is turned brass, it may lack certain details such as a breech line ring or elevating screw. Check your plan or do some research, then add the necessary details (Figure 4-14). Swivel guns were small weapons. Again, check the scale. Is the handle too large or incorrect? Sometimes kit manufacturers provide a standard stock fitting that is close, but not exactly what is shown on the plans. If so, cut off the handle, drill a hole in the barrel, make a new scale handle from wood or brass, and epoxy it into place.

Capstans and Windlasses

Early capstans and windlasses were made of wood. While some kits offer laser-cut wood parts, most supply brass turnings or castings that include carrick bitts and knees. Figure 4-15 shows a windlass with laser-cut knees and bitts on the left and a casting on the right. Consider replacing the cast bitts and knees with wooden ones. However, for a first-rate model, discard the casting and fashion the windlass from wood, especially if a natural finish is intended.

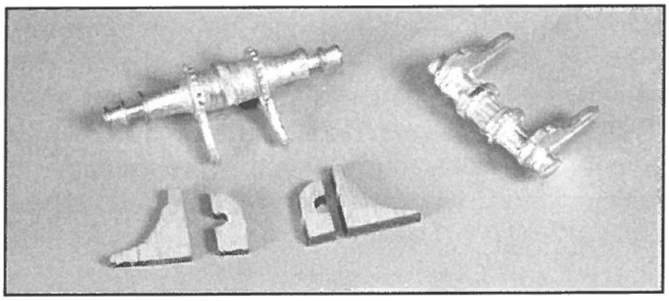


FIG. 4-15 – WINDLASS - CAST WITH WOOD
CARRICK BITTS AND ALL CAST

If you elect to use the castings as is, check for missing details. The capstan may lack bar holes in its head or whelps. Add them as required. Cut whelps from brass or wood sheet. Glue the parts together with epoxy. Mark the location of the bar holes, drill these openings, then square them up with a knife and chisel.

The windlass has many interesting details. The smallest one on a 19th century and later windlass is the connecting links between the quadrants and rocker arm. Don't use overscale wire or fittings for these links. If the casting looks too heavy, file down the links. If made from brass wire, select 0.010" diameter stock. These fittings are difficult to model at 1/8" scale or less. Rather than trying to fashion the part exactly like it should look and build it out of scale, fake it within scale. Figure 4-16 illustrates how.

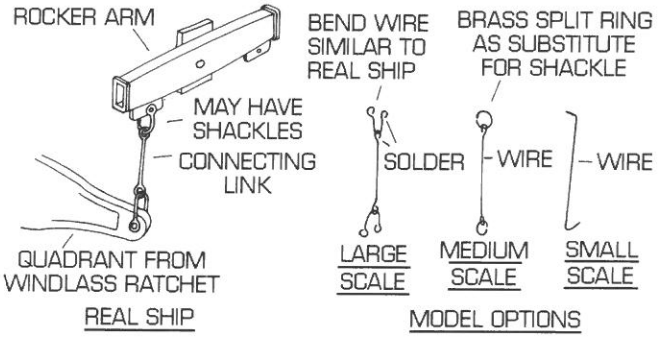

ROCKER ARM
MAY HAVE SHACKLES
CONNECTING LINK
QUADRANT FROM WINDLASS RATCHET
REAL SHIP
BEND WIRE SIMILAR TO REAL SHIP
BRASS SPLIT RING AS SUBSTITUTE FOR SHACKLE
SOLDER
WIRE
WIRE
LARGE SCALE
MEDIUM SCALE
SMALL SCALE
MODEL OPTIONS

FIG. 4-16 – CONNECTING LINKS ON A WINDLASS

Carvings

Many kits of 18th century and earlier ships contain precast decorative carvings for the bow, stern, and around gunports. Some are prepainted or plated. Examine them closely and use small needle files to remove flash. Clean up the carving with a #11 hobby blade and files. If the casting is too garish, prime it, then rub on a wax-based metallic finish or paint it with a toned down flat or semi-gloss. Figure 4-17 shows some castings from Mantua-PanArt's *Royal Caroline* kit. They are far too metallic looking and don't resemble woodcarvings at all.

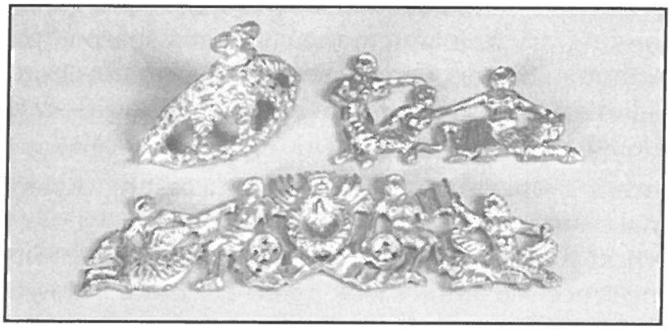


FIG. 4-17 – CAST CARVINGS

Often, kits don't include carvings, but adding them requires just a little effort and the will to try. Though plain, the carvings Bob Steinbrunn added to his *Fair American* enhance the model (Figure 4-18).

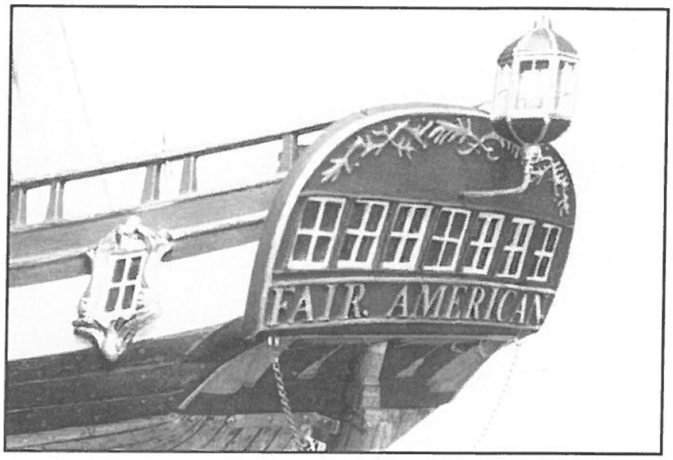

FAIR AMERICAN

FIG. 4-18 –
FAIR AMERICAN - STERN CARVING
MODEL & PHOTO BY ROBERT N. STEINBRUNN

Fife Rails

Laser-cut fittings, introduced in the early 1990s, have replaced many castings. Older Model Shipways' kits, however, still have britannia fife rails. Unfortunately, they aren't realistic, because fife rails were made of oak. However, if the real bitts were painted, it's acceptable to use the castings. Otherwise, fashion the rails and square bitts from stripwood. The bitt's round sections may present the biggest problem, but a lathe isn't necessary to do the job. Simply chuck a dowel into a drill and file to the correct shape.

Galley Stacks and Vents

Galley stacks and vents come in all kinds and sizes. Most often they are supplied as castings. Check if they are to scale and how they might be improved (Figure 4-19).

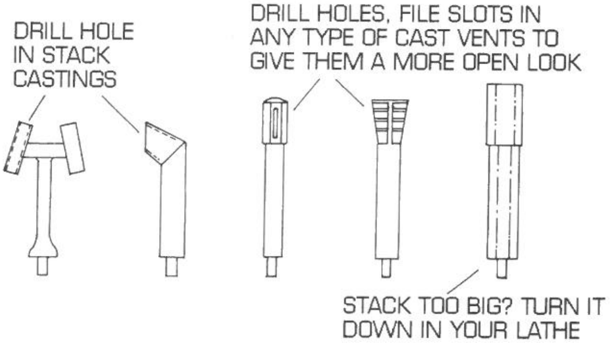

DRILL HOLE IN STACK CASTINGS
DRILL HOLES, FILE SLOTS IN ANY TYPE OF CAST VENTS TO GIVE THEM A MORE OPEN LOOK
STACK TOO BIG? TURN IT DOWN IN YOUR LATHE

FIG. 4-19 – GALLEY STACK & VENT CASTING IMPROVEMENTS

Hammock Rails and Stanchions

Most castings of hammock rails and stanchions (iron U-shaped cranes) are out of scale. It's easy to scratchbuild them this way, too. To solve the problem,

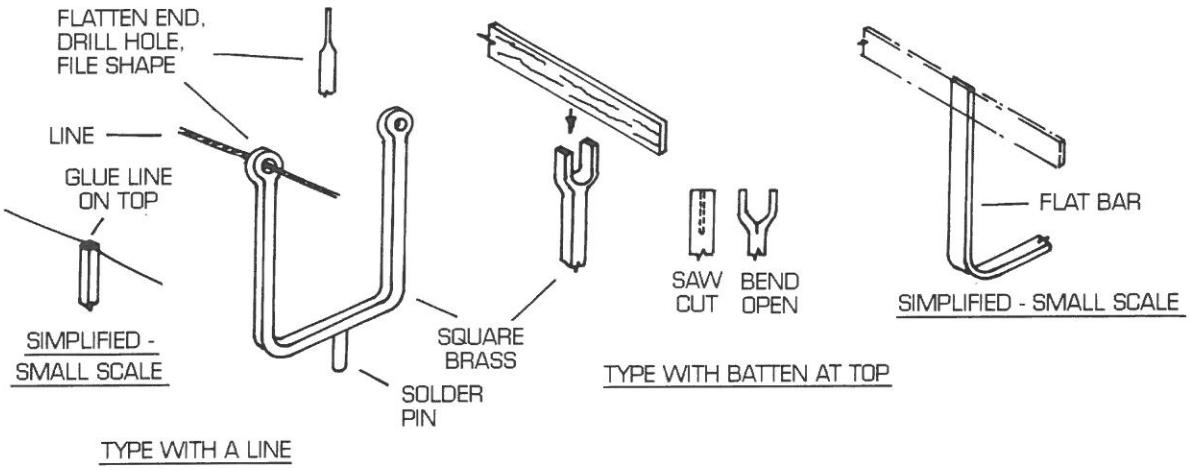


FIG. 4-20 - MAKING HAMMOCK STANCHIONS

Model Shipways' *Constitution* kit has photoetched parts. Most manufacturers, however, haven't reached this level of sophistication, so keep scale in mind as you work. If possible, file down "fat" stanchions. Figure 4-20 shows how to make stanchions from brass stock. Of course, what and how much detail is possible depends on the model's scale.

Ladders

Depending on the kit manufacturer, ladders come as castings, assembled or preformed wood strips, or stripwood for scratch building them. If the latter, make a fixture as shown in Figure 4-21.

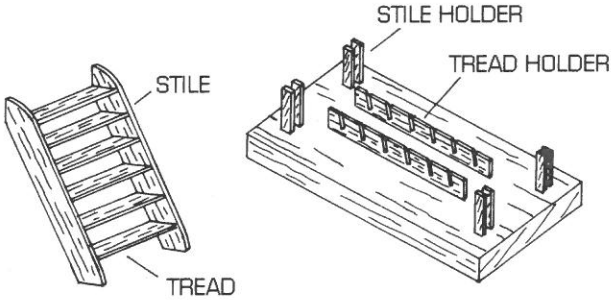


FIG. 4-21 - LADDER JIG

Like everything else on a model, ladders will look their best if they are to scale. Preformed stringers and treads are often too thick and, if possible, should be sanded down. Cast ladders present more of a problem. First, file down the thickness of the stringers, then the front edges of the treads so they at least look thinner.

Lettering

Some kits contain decals for Plimsoll numbers and the ship's name, but others don't. Lacking decals, the neatest way to apply names and numbers is with dry transfer lettering. Purchase these at art and office supply stores or model railroad shops. After applying the lettering, seal it with a coat of flat varnish. Another approach is to make a decal of the ship's name using dry transfer lettering on a clear decal sheet. Or, use your computer to generate the letters and print onto a clear decal sheet.

Rudders, Tillers, and Steering Wheels

Most rudders taper aft and sometimes from top to bottom as well. Many also carried preventer chains. Check the plans to avoid omitting these details. Use the smallest chain available if the scale size isn't manufactured.

Pintles and gudgeons may come as castings, or the instructions will say to fashion them from brass. Regardless of what is required, they should be to scale. If castings are too thick, file them down. Use the thinnest brass sheet in the kit to scratch build them (Figure 4-22). If the model is to 1/8" scale or less, consider using self-adhesive copper tape.

Hand-operated tillers on a visible deck often have a chamfer or other shape (Figure 4-23). When sanding, try to maintain the chamfer's sharp edge. Although this detail may not seem worth the effort, believe me, it is one of many that makes a first-rate model, especially when working in large scales.

Steering wheels are either wood or a casting. Again, make sure they are to scale. Generally, a wooden wheel is more out of scale than a cast one. Fat steering wheels just don't look good. Try filing it down, and if this doesn't work, it is best to look for a better scale wheel in one of the model company fitting catalogs. You will probably be looking for a cast wheel to fit the bill.

Although 10- or 12-spoke wheels are rare, they were fitted on some ships. If your plans call for one, chances are the kit contains a standard eight-spoke

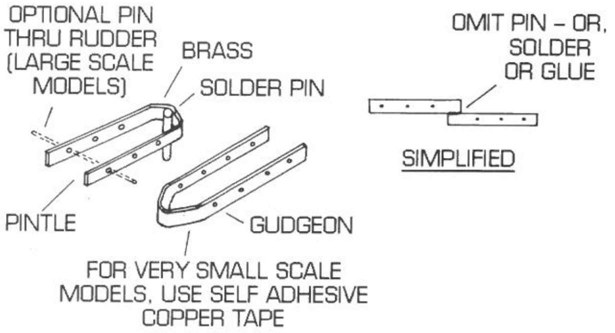

OPTIONAL PIN THRU RUDDER (LARGE SCALE MODELS)
BRASS
SOLDER PIN
OMIT PIN – OR, SOLDER OR GLUE
SIMPLIFIED
PINTLE
GUDGEON
FOR VERY SMALL SCALE MODELS, USE SELF ADHESIVE COPPER TAPE

FIG. 4-22 – SCRATCHBUILDING PINTLES & GUDGEONS

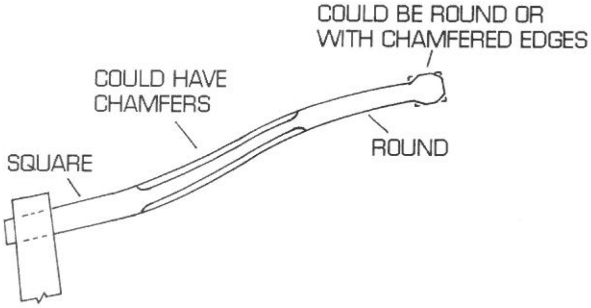


FIG. 4-23 – TILLER DETAIL

wheel sold as a separate fitting. As long as it is to scale, it's your option whether or not to use it. However, you'll probably have to scratch build the 6-, 10- or 12-spoke wheel.

PLASTIC KITS

Until recently, molding small parts was the most difficult aspect of manufacturing plastic ship models. This was especially true for modern warships. Then photoetched brass came along to fill the bill. Probably the first item to appear was photoetched railings for 1:350 and 1:700 scale warships. These parts were to scale and enhanced any model. Radars, watertight doors, and many other fittings followed. All were sold separately, but could turn a mediocre plastic naval vessel into a scale masterpiece. Model aircraft manufacturers were the first to include photoetched parts in their kits. Now ship kits are beginning to carry them, too.

Photoetched parts are delicate and must be handled with great care. Use a new #11 blade to separate fittings from the frame. Cut against a self-healing mat to avoid damaging the parts. If sprue remains, remove it with a fine needle file. Attaching photoetched parts can be troublesome at times, especially if they are small. Be patient and apply a film of cyanoacrylate. The impulse is to glob on the glue, but this ruins detail and paintwork.

When no photoetched parts are available, other options can make your model more scalelike and authentic. In Chapter 3, I told how to replace oversized railings with brass stanchions and thread railings. Check the scale and details of all structures and fittings for ways to improve the situation. Here are some suggestions:

Consider replacing plastic anchor stocks, thwarts (seats) and oars in ship's boats, and masts with wooden counterparts. Although it's possible to paint these items to look like wood, just a touch of real wood adds tremendously to the model's overall effect. Add missing details in open boats such as a furled sail on a mast. If cabins and companionways lack mouldings, install them. If mouldings are included but appear plain, cut them off and make new ones with a fancier design. Penetrate sealed port holes or windows, then glaze with glass or a glazing compound.

Is the rudder molded as part of the sternpost? Cut it free, then reattach using brass or styrene pintles and gudgeons. It will look more realistic as a hinged unit. Is the anchor chain molded into the deck? Sand it off and replace it with real chain, but pay attention to its scale and number of links. Some warships have embossed lettering on the hull. Sand this off and replace it with a decal.

Likewise, sand off heavy wood grain molded into deckhouses. Too much wood grain is unrealistic. If a deck should show planking and doesn't, scribe in the seams and butts with a needle in a mechanical pencil or other sharp instrument. If eyebolts molded onto structures and decks are out of scale, cut them off, drill a hole, and replace with smaller brass eyebolts or make them from wire. Do the same for similar small out-of-scale fittings, because plastic molds are incapable of reproducing these details fine enough.

CHAPTER 5
MASTS AND SPARS

WOOD KITS

This section applies primarily to sailing ships.

SHAPING AND TAPERING MASTS AND SPARS

Except perhaps for a square bowsprit, most kits provide round or tapered dowels for masts and spars. Model Shipways' kits once had tapered dowels, but replaced them with round stock. Tapering a round dowel is difficult. The best approach is to use a plane or hobby knife and slice the dowel from the spar's maximum diameter to square at the ends, then to eight-sided, or even 16-sided. Now file and sand it round. This approach prevents turning a round dowel into an oval (Figures 5-1 and 5-2). If the taper is slight you may not be able to cut down to a square. In this case, cut four sides into an octagon shape close to the final diameter, then sand round. Although a little tricky, the taper can be sanded in by chucking a dowel into an electric drill or lathe.

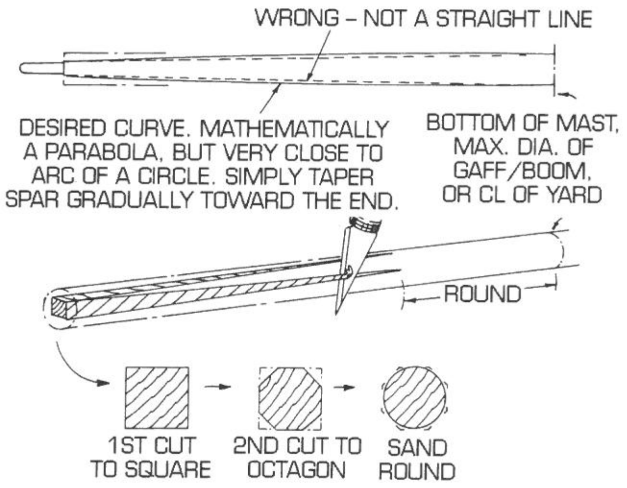

WRONG – NOT A STRAIGHT LINE
DESIRED CURVE. MATHEMATICALLY A PARABOLA, BUT VERY CLOSE TO ARC OF A CIRCLE. SIMPLY TAPER SPAR GRADUALLY TOWARD THE END.
BOTTOM OF MAST, MAX. DIA. OF GAFF/BOOM, OR CL OF YARD
ROUND
1ST CUT TO SQUARE
2ND CUT TO OCTAGON
SAND ROUND

FIG. 5-1 – TAPERING DOWELS

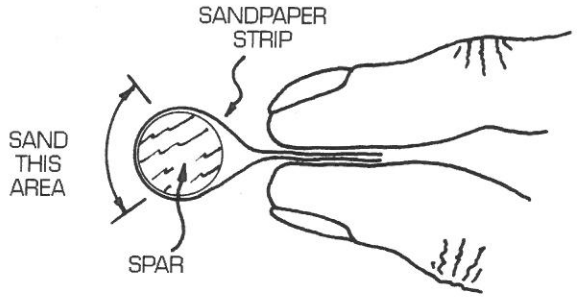

SANDPAPER STRIP
SAND THIS AREA
SPAR

FIG. 5-2 – SPAR SANDING

Note: This is important! A spar's taper is more of a parabola and not a straight line as noted on Figure 5-1. Figure 5-3 shows one method of how to accurately determine the curve. However, the important thing is to keep the general shape of the curve in mind. For a model, a gradual tapered curve is all that is needed.

Dowels are usually sized to the diameter of a mast's or spar's round sections. If it has a square or eight-sided (octagon) section, add wood strips to make up the diameter (Figure 5-4). Figure 5-5 depicts the shape of a yard on older ships.

Option 1- Use Larger Dowels

If adding wood to a dowel isn't appealing, here are some other options. Selecting dowels sized to the corners across a square or octagon eliminates adding extra wood. However, this means reducing the dowel to the spar's round diameters after cutting the square or octagon. Sand or file the spar eight-sided, save the octagon where required, then cut

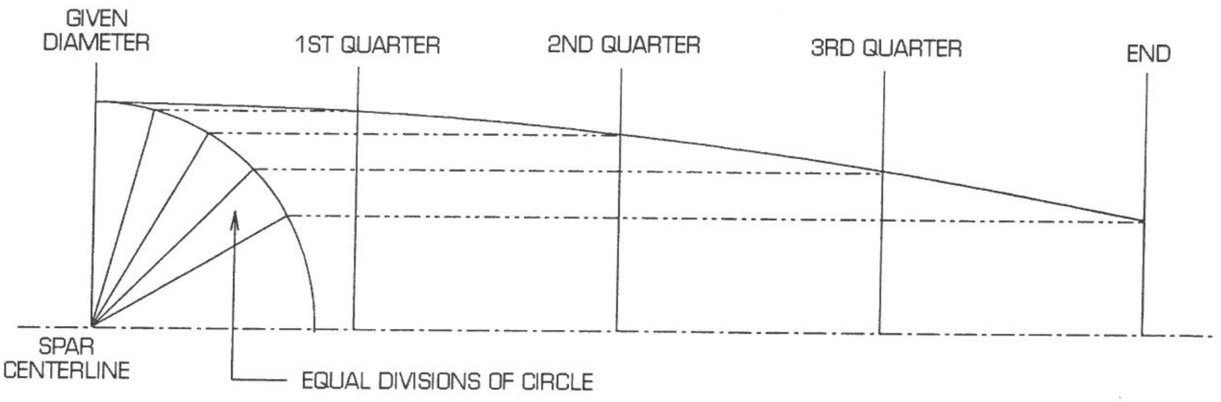

GIVEN DIAMETER
1ST QUARTER
2ND QUARTER
3RD QUARTER
END
SPAR CENTERLINE
EQUAL DIVISIONS OF CIRCLE

FIG. 5-3 – METHOD FOR DETERMINING SPAR TAPERS

16-sided and sand round. Or, just sand the eight-sided dowel round.

Option 2 - Substitute Square Stock

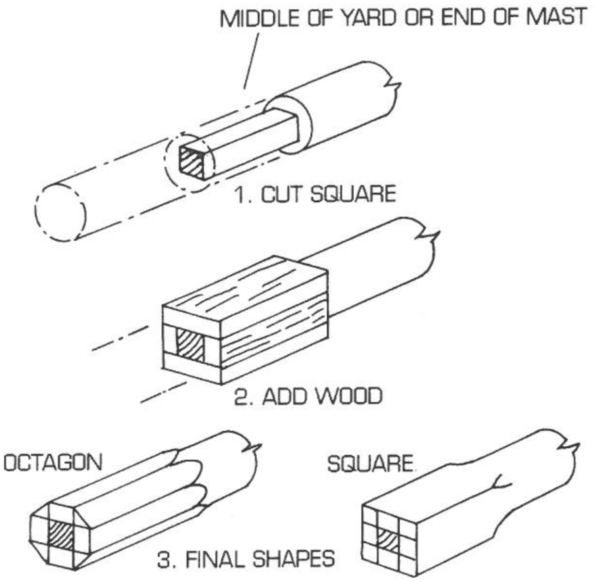

MIDDLE OF YARD OR END OF MAST
1. CUT SQUARE
2. ADD WOOD
OCTAGON
SQUARE
3. FINAL SHAPES

FIG. 5-4 – SPAR DIAMETER BUILD-UP

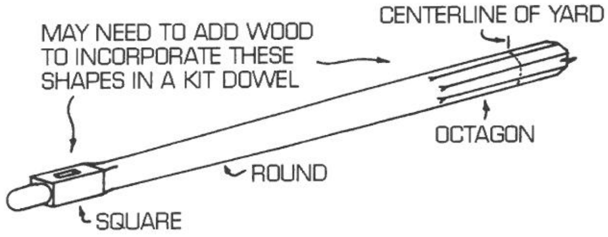

MAY NEED TO ADD WOOD TO INCORPORATE THESE SHAPES IN A KIT DOWEL
CENTERLINE OF YARD
OCTAGON
ROUND
SQUARE

FIG. 5-5 – YARD WITH VARIOUS SHAPES

Many experienced modelers discard the dowels and make masts and spars from square stock. They prefer selecting their own wood and find it easier to mark tapers and eight-sided sections. Although kits probably won't contain the larger dowels and square stock, they may have enough extra material in the required sizes to do the job. If not, purchase additional wood (basswood, port oxford cedar, sugar pine, or applewood are some options).

Option 3 - No Squares and Octagons

Not recommended for a first-rate model

Mast and Spar Tapers

An important element to look for on the plans is how a mast or spar tapers. Never assume they narrow uniformly. Many had one flat face. For example, the forward edge of a mast on a schooner may be flat with the aft, port, and starboard sides tapered. This was done so the mast hoops rode along a straight line. It also keeps the mast looking natural when bent by a load. On a boom and gaff, the straight side may be next to the sail so its lacing is uniform; or, on a modern craft, to accept the metal track securing the sail. The point is, check the plans and don't make any assumptions.

A few kits provide rough-tapered dowels. Some are good and some are not. Figure 5-6 shows how to correct bad tapers and what to discard.

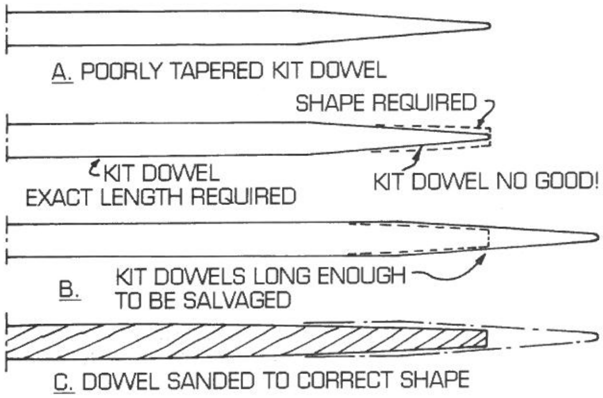

A. POORLY TAPERED KIT DOWEL
SHAPE REQUIRED
KIT DOWEL
EXACT LENGTH REQUIRED
KIT DOWEL NO GOOD!
B. KIT DOWELS LONG ENOUGH TO BE SALVAGED
C. DOWEL SANDED TO CORRECT SHAPE

FIG. 5-6 – TAPERED KIT DOWELS

MAST AND OTHER RIGGING FITTINGS

Around the beginning of the 19th century, more and more metal fittings began appearing on masts, spars, and other rigging items. Some kits duplicate these with britannia castings, while others provide brass strips or wire from which to scratch build them. On a real ship, ironwork is hardly noticeable, so scale is important. Check castings for scale thicknesses and, if necessary, file them down.

I am a stickler for using metal where it was metal on real ships. Consequently, I don't recommend substituting paper strips for ironwork. Fashion ironwork from brass or copper sheets, wire, and rods. To duplicate mast bands on small scale models, consider using self-adhesive or nonadhesive copper tape (the same product used to copper hulls). Figure 5-7 and 5-8 illustrates some possible fittings. Refer to Chapter 2 on how to solder.

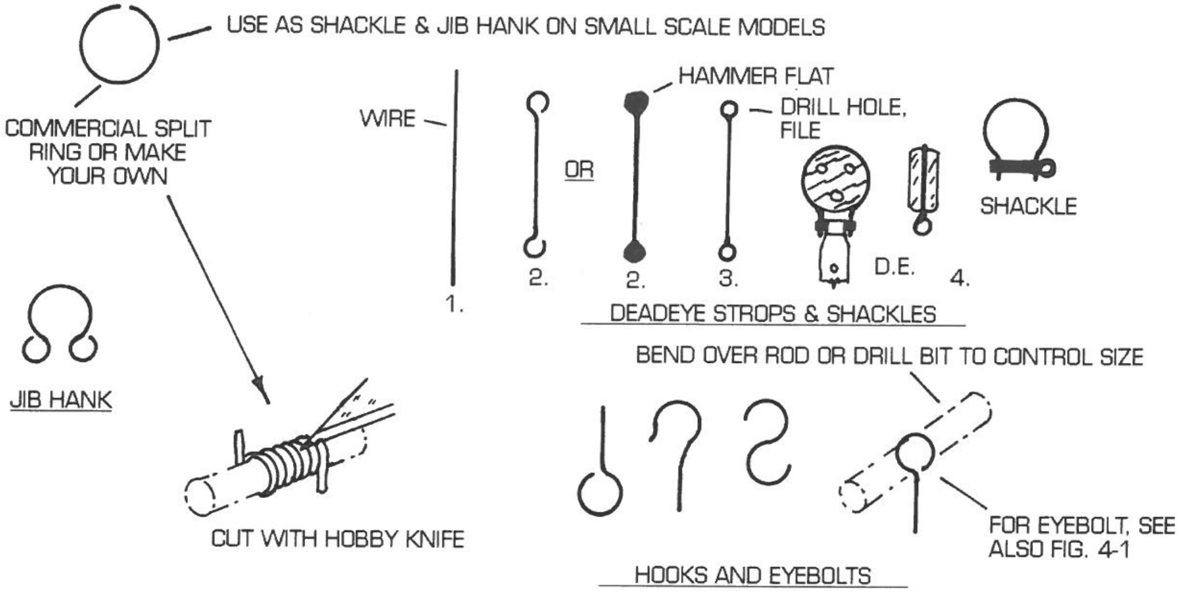
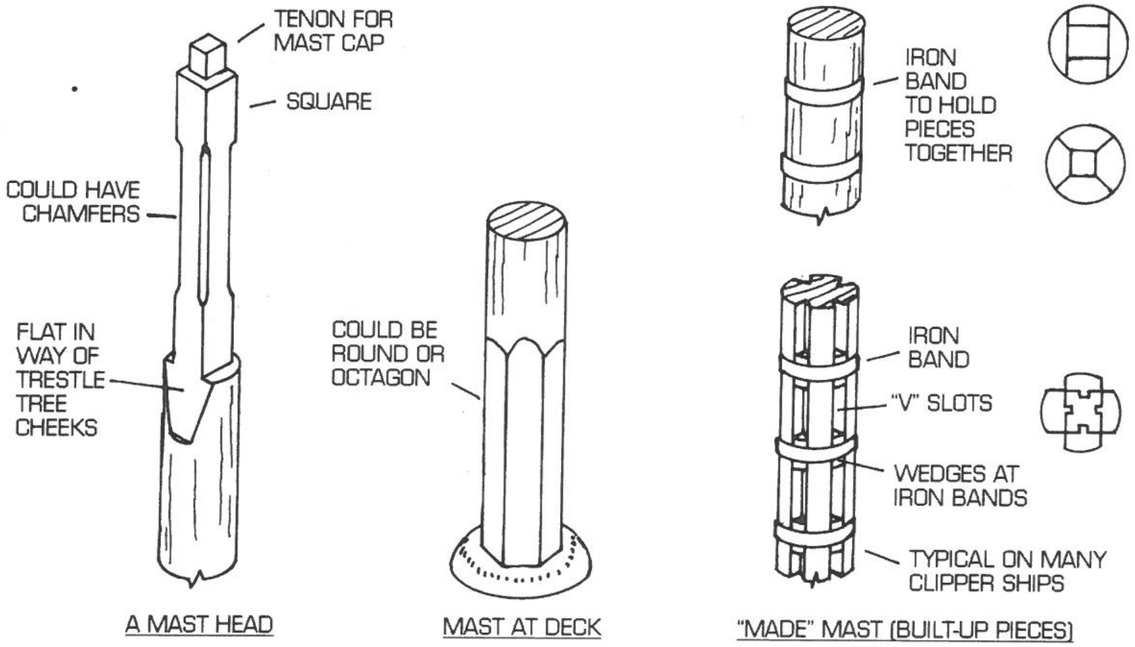

USE AS SHACKLE & JIB HANK ON SMALL SCALE MODELS
COMMERCIAL SPLIT RING OR MAKE YOUR OWN
WIRE
OR
HAMMER FLAT
DRILL HOLE, FILE
SHACKLE
1.
2.
2.
3.
D.E.
4.
DEADEYE STROPS & SHACKLES
JIB HANK
BEND OVER ROD OR DRILL BIT TO CONTROL SIZE
CUT WITH HOBBY KNIFE
FOR EYEBOLT, SEE ALSO FIG. 4-1
HOOKS AND EYEBOLTS

FIG. 5-8 – FITTING FROM WIRE & ROD

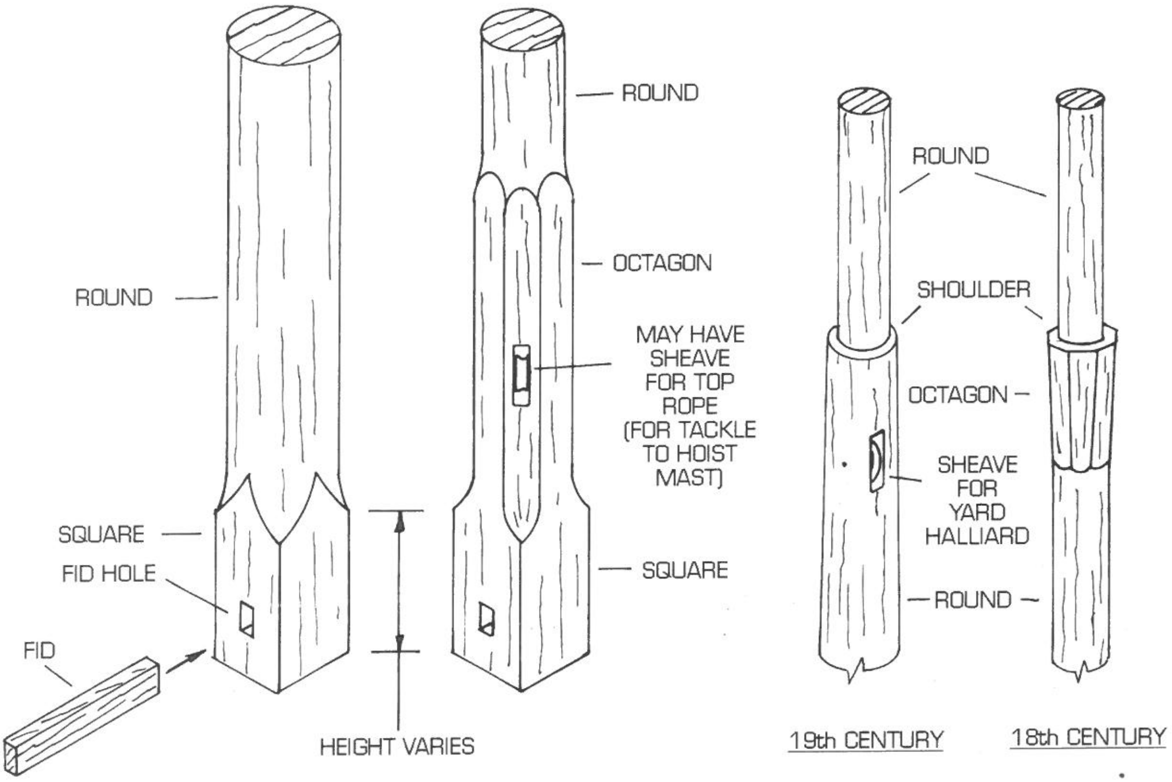

TENON FOR MAST CAP
SQUARE
COULD HAVE CHAMFERS
FLAT IN WAY OF TRESTLE TREE CHEEKS
COULD BE ROUND OR OCTAGON
IRON BAND TO HOLD PIECES TOGETHER
IRON BAND
"V" SLOTS
WEDGES AT IRON BANDS
TYPICAL ON MANY CLIPPER SHIPS

A MAST HEAD

MAST AT DECK

"MADE" MAST (BUILT-UP PIECES)

FIG. 5-9 – SOME LOWER MAST DETAILS


ROUND
ROUND
OCTAGON
MAY HAVE SHEAVE FOR TOP ROPE (FOR TACKLE TO HOIST MAST)
SQUARE
SQUARE
FID HOLE
FID
HEIGHT VARIES
ROUND
SHOULDER
OCTAGON
SHEAVE FOR YARD HALLIARD
ROUND
19th CENTURY
18th CENTURY

TOPMAST HEELS

TOPMAST HEADS

FIG. 5-10 – TOPMAST DETAILS

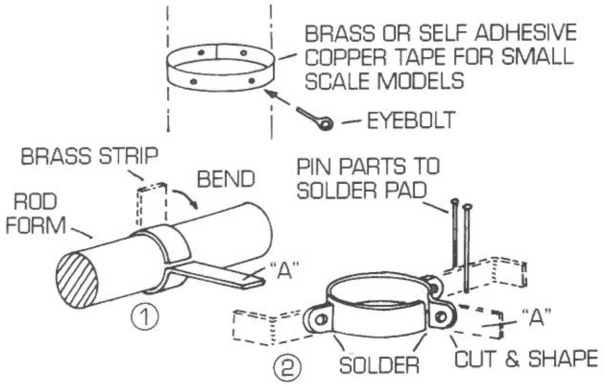

BRASS OR SELF ADHESIVE COPPER TAPE FOR SMALL SCALE MODELS
EYEBOLT
BRASS STRIP
BEND
ROD FORM
PIN PARTS TO SOLDER PAD
"A"
①
"A"
②
SOLDER
CUT & SHAPE

FIG. 5-7 – MAKING MAST BANDS

BUILDING AND INSTALLING MASTS

Fore, Main, and Mizzenmasts

Refer to the plans, then shape the lower mast sections with a hobby knife or files. Square the mastheads to their proper widths, then cut the tenon at the top for the mast cap. Depending upon the ship, the head's four corners may be beveled. At the deck, the mast may be round or octagon. A basic mast could be round or, if *fished* (put together in pieces), have grooves and iron bands to hold the mast together. Figure 5-9 illustrates some lower mast details. For the one with slots, found on many clipper ships, I have shown how the mast was constructed to produce the slots. Some topmasts on old ships are square at the heel, become eight-sided, then round, return to eight-sided, and finish square at the head. Later ships had square topmast heels, then round above. Again, this depends upon the ship's design and time period. The heel has a rectangular slot for a *fid* (iron or wooden pin preventing the mast from falling through the top). Drill a hole to start the slot, then shape it with a file. Figure 5-10 shows some typical topmast details.

Topgallant/royal masts are usually similar to topmasts.

After assembling the basic mast components, drill the required sheave holes (usually for yard halliard tyes). Don't worry about installing the sheaves (pulleys) on small scale models, because lines cover them, making the extra work invisible and unnecessary. Lastly, mount all the cleats, eyebolts, and other fittings on each mast.

Spanker or Spencer Masts

Spanker or spencer masts are aft of a lower mast. They usually don't taper, but may be square at the deck. Caution! Before installing them, slip on any mast hoops. Even if displaying the model without sails, the hoops should lie in a pile on the mast. If the kit doesn't contain hoops, make them from wood or use painted brass rings.

Mast Caps, Tops, Trestletrees, and Cross-trees

Wooden tops are simple and fun to make. Curved pieces such as the basic top (platform), rim, cheeks, trestletrees, and curved topmast cross-trees are either laser- or die-cut wood, or scratch built. Relatively straight parts are usually made from stripwood. Although a few manufacturers still supply metal cast tops, they are heavy, and sometimes not to scale. Consider discarding them and scratch build authentic ones from wood. Figure 5-11 illustrates the lower top from Model Shipways' *Niagara* kit.

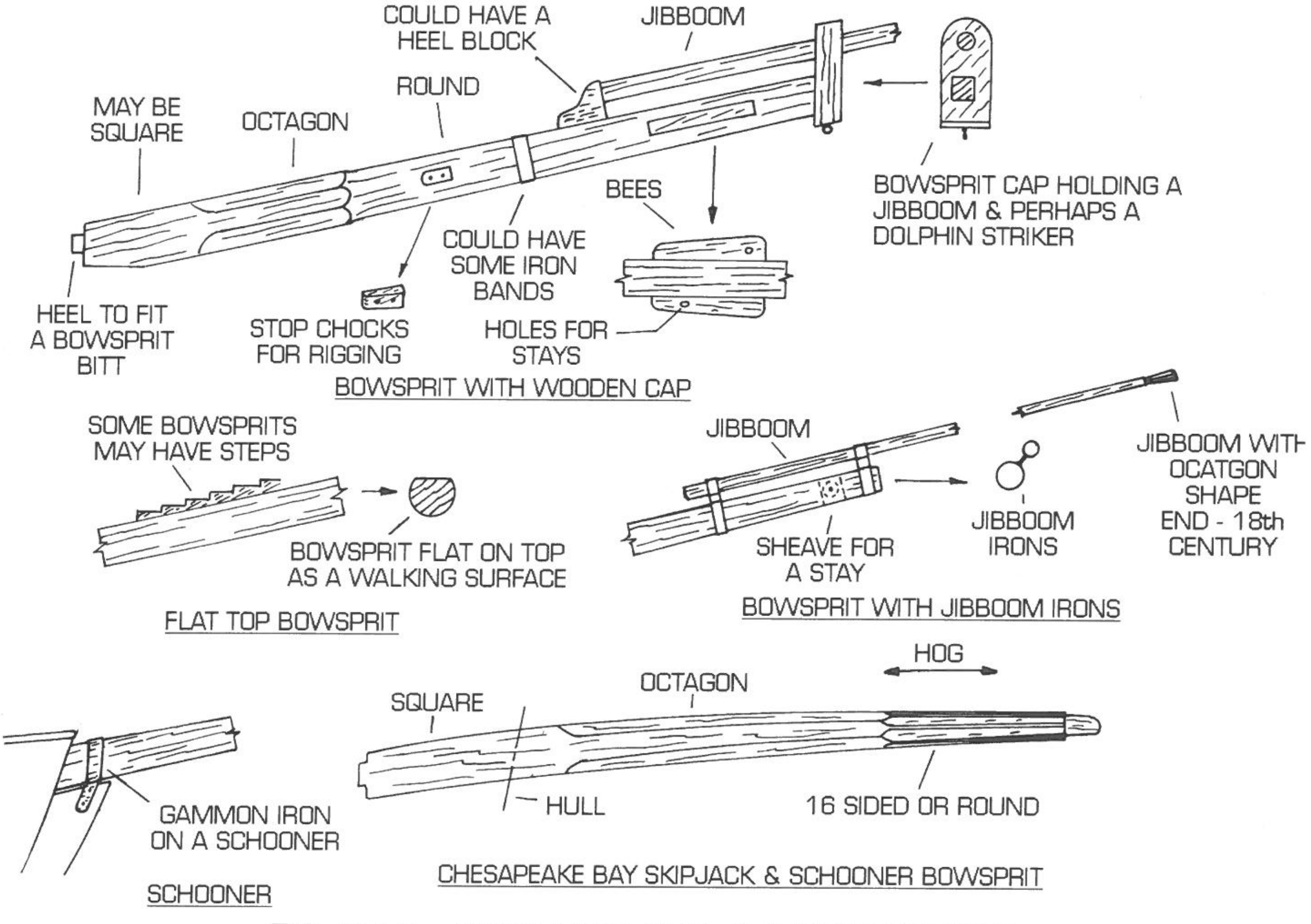
Mast Assembly

With all parts made and prefitted, glue and pin tops, caps, cross-trees, and trestletrees to the lower masts, topmasts, and topgallant/royal masts. Before attaching the lower mast, topmast, and topgallant/royal masts, check and double check their alignment. Look from the side, front, and rear. Adjust the upper mast heel holes if necessary.

Option: Some modelers like to build mast assemblies as they rig. If so, install the lower masts, rig the shrouds and lower stays, then add the topmasts, etc. Again, keep checking alignment as work progresses.

Mast Wedges and Mast Installation

A casting could represent mast wedges covered by canvas (mast coat), or the kit may supply laser-cut wood (Figure 5-12). The latter requires filing the edge and angling the hole to the rake of the mast. Slip on this piece before installing the masts, then step them through the deck. Check the forward, aft, and athwartships alignments against the plans. If an angle is off, cautiously file the hole in the deck to adjust it. Once correct, add slivers of wood to hold the mast in place. Finally, slide the mast coat down onto the deck. Glue the mast coat to the mast, but *not to the deck*, because further adjustments may be required as you rig. Also,


COULD HAVE A HEEL BLOCK
JIBBOOM
ROUND
MAY BE SQUARE
OCTAGON
BEES
BOWSPRIT CAP HOLDING A JIBBOOM & PERHAPS A DOLPHIN STRIKER
COULD HAVE SOME IRON BANDS
HEEL TO FIT A BOWSPRIT BITT
STOP CHOCKS FOR RIGGING
HOLES FOR STAYS
SOME BOWSPRITS MAY HAVE STEPS
JIBBOOM
JIBBOOM WITH OCATGON SHAPE END - 18th CENTURY
BOWSPRIT FLAT ON TOP AS A WALKING SURFACE
SHEAVE FOR A STAY
JIBBOOM IRONS
HOG
OCTAGON
SQUARE
HULL
16 SIDED OR ROUND
GAMMON IRON ON A SCHOONER

BOWSPRIT WITH WOODEN CAP

FLAT TOP BOWSPRIT

BOWSPRIT WITH JIBBOOM IRONS

SCHOONER

CHESAPEAKE BAY SKIPJACK & SCHOONER BOWSPRIT

FIG. 5-13 – BOWSPRIT AND JIBBOOM DETAILS

the model will eventually require restoration and the masts should be easy to remove.

BUILDING AND INSTALLING BOWSPRITS, JIBBOOMS, FLYING JIBBOOMS, AND DOLPHIN STRIKERS

Bowsprits, Jibbooms, and Flying Jibbooms

Many bowsprits are unique. They may start square inboard with chamfers, then become octagonal, and turn round outboard. The bowsprit on a Chesapeake Bay skipjack, such as Model Shipways' *Willie Bennett,* has a downward hog. Most bowsprits on three-masted ships have wooden bees, iron bands, or cleats. Bowsprits on schooners aren't as elaborate and are easier to construct.

The jibboom could start as an octagon, turn round, then go back to an octagon. It may have sheave holes. Figure 5-13 illustrates some bowsprit and jibboom details. Carefully follow the plans so as not to overlook these interesting details.

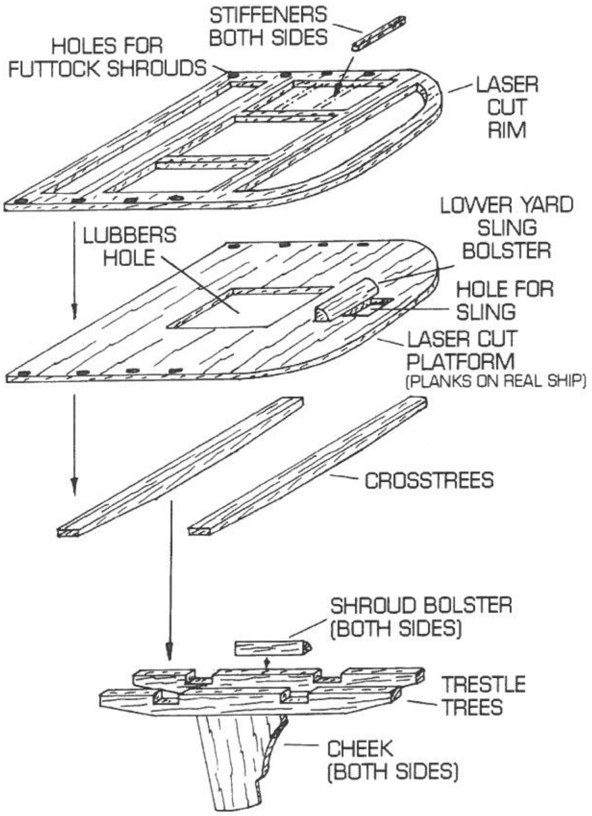

STIFFENERS
BOTH SIDES
HOLES FOR
FUTTOCK SHROUDS
LASER
CUT
RIM
LOWER YARD
SLING
BOLSTER
LUBBERS
HOLE
HOLE FOR
SLING
LASER CUT
PLATFORM
(PLANKS ON REAL SHIP)
CROSSTREES
SHROUD BOLSTER
(BOTH SIDES)
TRESTLE
TREES
CHEEK
(BOTH SIDES)

FIG. 5-11 – TOP ON NIAGARA MODEL

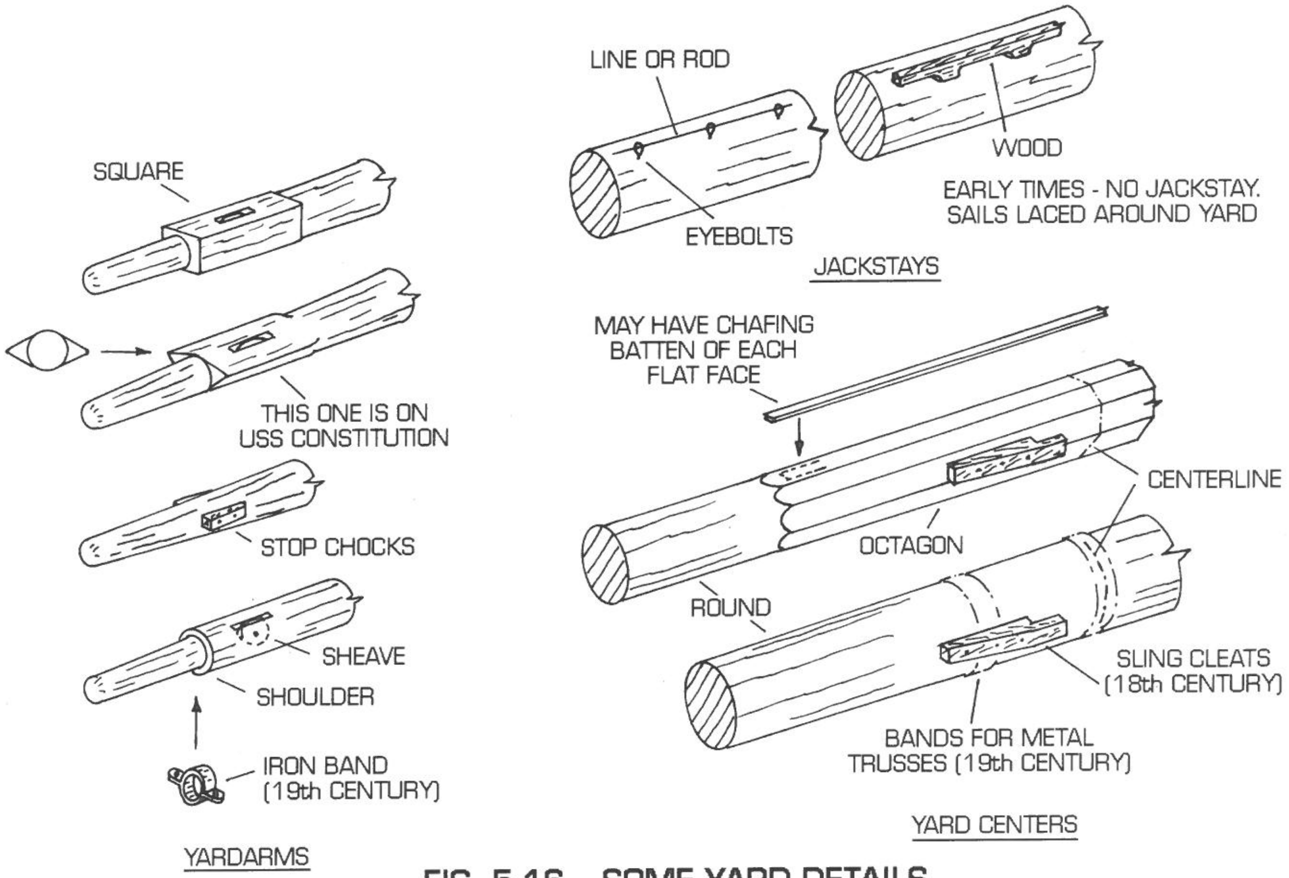
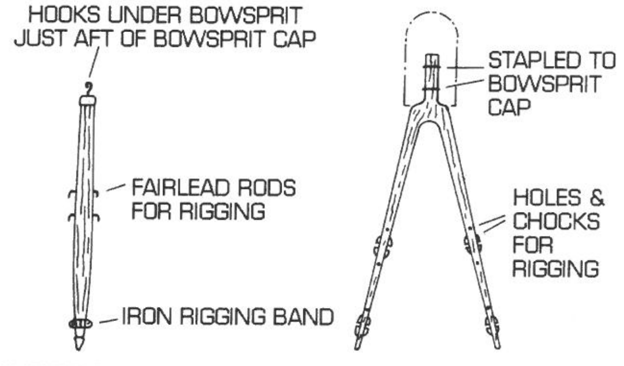

LINE OR ROD
EYEBOLTS
WOOD
EARLY TIMES - NO JACKSTAY.
SAILS LACED AROUND YARD
JACKSTAYS
SQUARE
THIS ONE IS ON
USS CONSTITUTION
STOP CHOCKS
SHEAVE
SHOULDER
IRON BAND
(19th CENTURY)
YARDARMS
MAY HAVE CHAFING
BATTEN OF EACH
FLAT FACE
CENTERLINE
OCTAGON
ROUND
SLING CLEATS
(18th CENTURY)
BANDS FOR METAL
TRUSSES (19th CENTURY)
YARD CENTERS

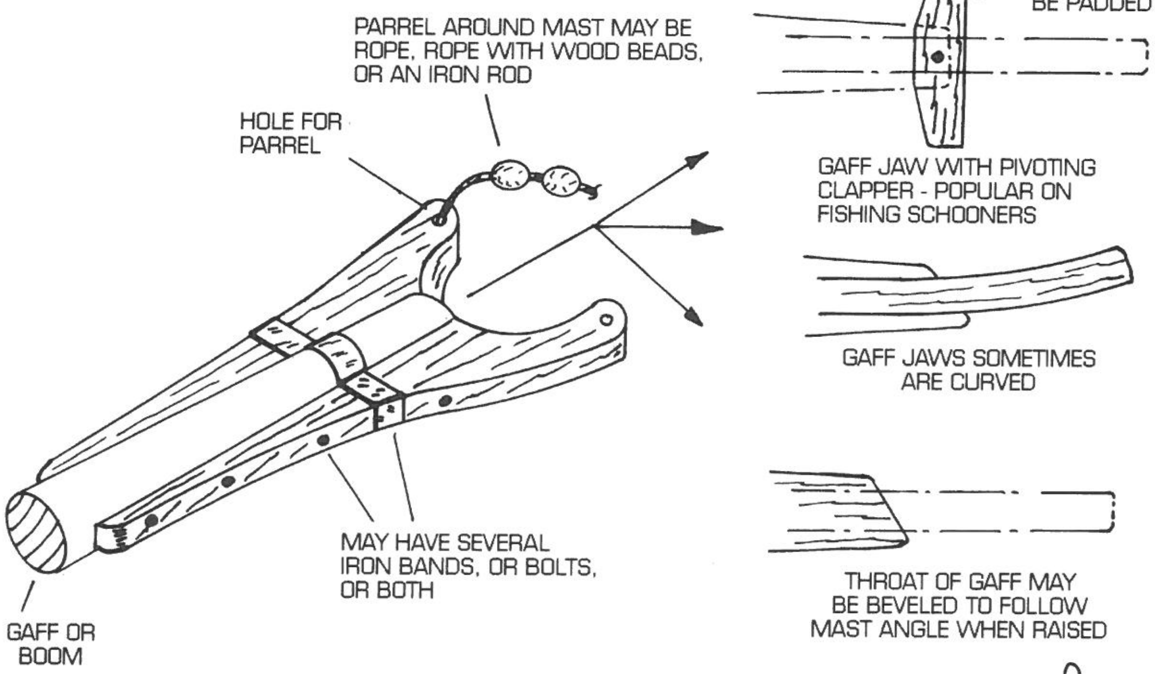
FIG. 5-16 – SOME YARD DETAILS


HOOKS UNDER BOWSPRIT JUST AFT OF BOWSPRIT CAP
FAIRLEAD RODS FOR RIGGING
IRON RIGGING BAND
STAPLED TO BOWSPRIT CAP
HOLES & CHOCKS FOR RIGGING

CLIPPER FLYING FISH

USS CONSTITUTION

FIG. 5-15 – DOLPHIN STRIKERS


PARREL AROUND MAST MAY BE ROPE, ROPE WITH WOOD BEADS, OR AN IRON ROD
HOLE FOR PARREL
FACE MAY BE PADDED
GAFF JAW WITH PIVOTING CLAPPER - POPULAR ON FISHING SCHOONERS
GAFF JAWS SOMETIMES ARE CURVED
MAY HAVE SEVERAL IRON BANDS, OR BOLTS, OR BOTH
THROAT OF GAFF MAY BE BEVELED TO FOLLOW MAST ANGLE WHEN RAISED
GAFF OR BOOM

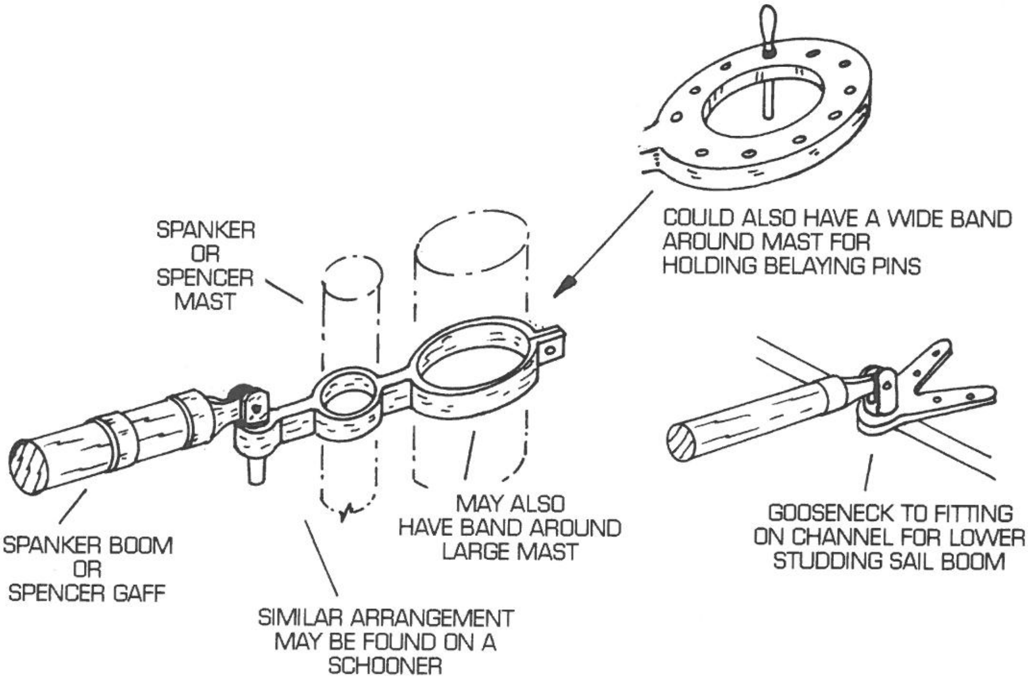

SPANKER OR SPENCER MAST
COULD ALSO HAVE A WIDE BAND AROUND MAST FOR HOLDING BELAYING PINS
MAY ALSO HAVE BAND AROUND LARGE MAST
GOOSENECK TO FITTING ON CHANNEL FOR LOWER STUDDING SAIL BOOM
SPANKER BOOM OR SPENCER GAFF
SIMILAR ARRANGEMENT MAY BE FOUND ON A SCHOONER

FIG. 5-18 – GOOSENECKS

A flying jibboom is usually round, but may have a short octagon section at its heel. This boom is usually mounted off center so stays can pass around the jibboom's head or through sheaves in the boom. Depending on the period, booms were secured either by iron bands or a rope seizing. The plans should show this, but if not, refer to a book from the reference list in Appendix A. Figure 5-14 illustrates the flying jibboom on *USS Constitution.*

Dolphin Strikers

Dolphin strikers can be a single spar hanging under the bowsprit cap, or may split into a two-legged spar. Drill holes or add chocks as required. The critical element is mounting the dolphin striker at its correct angle. Refer to the plans for this. Figure 5-15 illustrates the dolphin strikers on *Flying Fish* and *Constitution.*

Installation

When installing the bowsprit, jibboom, (and flying jibboom) assembly, carefully check the alignment and maintain it during rigging. It's easily pulled off center.

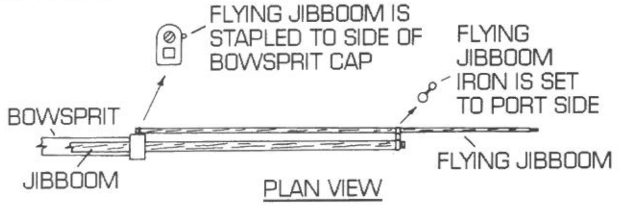

FLYING JIBBOOM IS STAPLED TO SIDE OF BOWSPRIT CAP
FLYING JIBBOOM IRON IS SET TO PORT SIDE
BOWSPRIT
JIBBOOM
FLYING JIBBOOM
PLAN VIEW

FIG. 5-14 – USS CONSTITUTION FLYING JIBBOOM

BUILDING YARDS

Yards can be fabricated at any time, but install them with the rigging. However, footropes and jackstays are easier to add with the yards in hand, as are cleats, sheaves, and other ironwork. Drilling a sheave hole is difficult once the yard is bent to the model. Furthermore, fat yards look horrible, so pay attention to their scale. Figure 5-16 shows some yard details.

Reminder: Paint or varnish the yards before setting them aside. All painting must be completed before rigging commences.

BUILDING SPANKER OR SPENCER GAFFS AND BOOMS

While a yard's largest diameter is at the centerline, a boom or gaff may have it about one-third its length from the mast. Carefully check the plans carefully for the proper dimensions at various points. Complete as much of these spars as possible in hand and install later.

The boom and gaff may have jaws. These are castings or wood in a kit (Figure 5-17). Some booms have a gooseneck instead of jaws. See Figure 5-18 for details.

PLASTIC KITS

Small diameter spars, such as a royal yard, are flexible. They may warp from heat or bend due to rigging strain. Consider replacing flimsy spars with wooden ones. For more realism, substitute wood for all masts and spars, especially if they are stained. However, that may be going too far. My objective is to produce a quality model without deviating too much from what's in the kit.

Check the fittings on masts and spars. If molded as part of the spar, they could be out of scale. If so, cut them off and make new plastic or brass fittings that are to scale (refer to Appendix A).

CHAPTER 6
GENERAL RIGGING INFORMATION

This and the following chapter are not specific due to variances in ships. However, I've provided general guidelines and procedures applicable to most rigs. Rigging varied from century to century and nation to nation. While the kit's plans may be correct, don't bet on it. Purchase a book on rigging practices from your ship's period, then cross-check the plans. Flag out any errors in the rig.

RIGGING OPTIONS FOR WOODEN KITS

Many plans show the ship with a full set of sails. However, the model can be rigged four ways. Before deciding, consider this: Professional restorers know sails are the first item to deteriorate on a model and are responsible for much of the damaged rigging.

Full set including fore-and-aft and square sails. Not many modelers go to this extreme, because the mass of sails obscures most deck and spar details. Sails look better on a ship at sea.

Sails furled, yards lowered on their lifts: This is a pleasing compromise. Reality is maintained without sacrificing detail.

Some sails furled, others hoisted: This creates the illusion of a ship in port with some sails still drying after a day's run. Mix furled sails with open ones or sails half up. Possibilities abound, so look for a pleasing effect. Study marine paintings for ideas. Marine artist John Stobart's work is an ideal reference.

No sails, yards lowered on their lifts: Now the ship is in port with her sails removed for repairs. Most modelers choose this approach, and beginners should definitely select it.

RIGGING PLANS

A kit's rigging plans and instruction manual should contain all the details concerning masts, spars, and their attendant rigging, Rigging plans are often confusing. Numerous lines overlap and conceal details. Again, refer to Appendix A and purchase a complementary book describing the complete rig and its run. Compare text to plans and mark any inaccuracies.

RIGGING LINE AND BLOCK SIZES

Some plans or instructions list rigging line and block sizes, but many don't. If the latter, consult a book such as Biddlecombe's. Even when diameters are known, the kit doesn't contain every size of line or block, so group the sizes for consistency. The following table illustrates how.

Lines on plan	**Lines in Kit**
Less than 0.009″	0.005″ thread
0.009″ to 0.015″	0.010″
0.016″ to 0.026″	0.021″
0.027″ to 0.036″	0.031″
0.037″ to 0.046″	0.041″
0.047″ to 0.055″	0.051″

To enhance a model's scalelike appearance, use every diameter provided and purchase those sizes (if available) not in the kit. This adds tremendously to the overall visual effect.

Block sizes on real ships are in 1″ increments such as 4″, 5″, 6″, and 7″. Occasionally 1/2″ increments apply. These may be shown on kit plans. If not, look up the sizes in your reference books. Manufactured kit blocks aren't always to size, so select the closest one. (When in doubt, choose the smaller of the two.) Or, sand a block to its correct length. Here's an example of what to do:

Block Sizes	**Blocks in Kit**
Single 1/16″ to 3/32″	3/32″
Double 1/16″ to 3/32″	1/8″
7/64″ and 1/8″	1/8″
9/64″ and 5/32″	5/32″
11/64″ and 3/16″	3/16″

Model Shipways' kits contain the above block sizes. Some foreign kits provide a big bag of blocks all the same size. This is inappropriate for any ship, for blocks decreased in length as their height above deck increased. Purchase additional sizes to improve your model's authenticity.

Deadeyes & Bullseyes	**In Kit**
1/16″ to 7/64″	3/32″
1/8″ to 9/64″	1/8″
5/32″	5/32″
3/16″	3/16″

Wire rigging began showing up in the 20th century. Being stronger, the sizes are smaller than hemp cordage. The rope lanyards on wire shrouds were often larger in diameter than the shroud. Keep this in mind when rigging these vessels.

TREATING LINES

Worming, parceling and serving: Lines on ships were wormed, parceled, and served wherever chafing might occur. Shrouds are a prime example. Worming inserts thin pieces of line (worms) between the strands. Parceling winds canvas strips saturated with tar around the wormed part. Then the wormed and parceled area is *served* (bound in the opposite direction with spun yarn). Serving is the only necessary procedure. However, most modelers omit it, preferring to use the line as is after applying a heavy coat of beeswax. Those striving for a first-rate model should serve the appropriate lines with silk, waxed polyester, or linen thread. Avoid fuzzy cotton unless treated with a heavy coat of beeswax beforehand. See Figure 6-1.

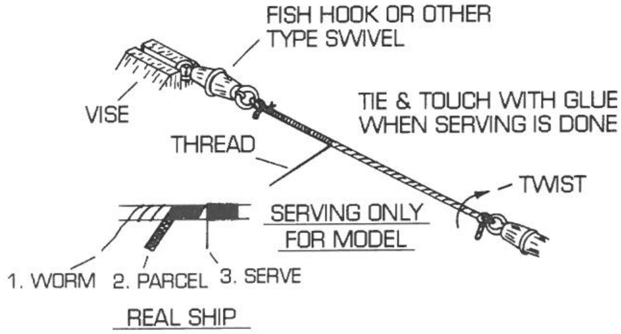

FISH HOOK OR OTHER TYPE SWIVEL
VISE
TIE & TOUCH WITH GLUE WHEN SERVING IS DONE
THREAD
TWIST
SERVING ONLY FOR MODEL
1. WORM
2. PARCEL
3. SERVE
REAL SHIP

FIG. 6-1 – SERVING RIGGING LINES

Seizings and Eye Splices: Seize lines with polyester or silk, then touch with diluted white glue or thin cyanoacrylate. Fake eye splices by seizing the lines together. (Figure 6-2). Include real eye splices if a line is large enough to permit it (Figure 6-3).

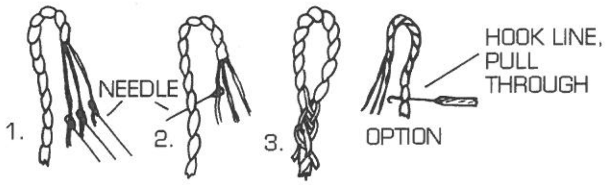

1.
NEEDLE
2.
3.
HOOK LINE, PULL THROUGH
OPTION

FIG. 6-3 – REAL EYESPLICE

Beeswax: Protects lines against moisture and lays down fuzz. To soften beeswax, hold it to a light bulb. Run the line across the beeswax, then through your fingers to soften and smooth it. Do this several times to thoroughly coat the line.

BELAYING PINS, CLEATS, AND THEIR LINES

A belaying plan saves a lot of guesswork, but isn't always included. If not, find a belaying plan for a similar ship and use it as a guide. Some lines reeve through fairleads before belaying, so keep this in mind.

Even if a kit has a belaying plan, every captain had his own ideas about how lines belayed. Because no set rules exist, it's permissible to alter the plan's belaying points. Just use sound judgment. A logical run becomes easier to detect as rigging progresses. Also, installing only a few or no sails opens more suitable pins or cleats and the opportunity to alter belaying points. belaying points.

RIGGING TOOLS

Commercial tools are available, but it's possible to make your own. The dark handled ones in Figure 6-4 are commercial hooks with push-

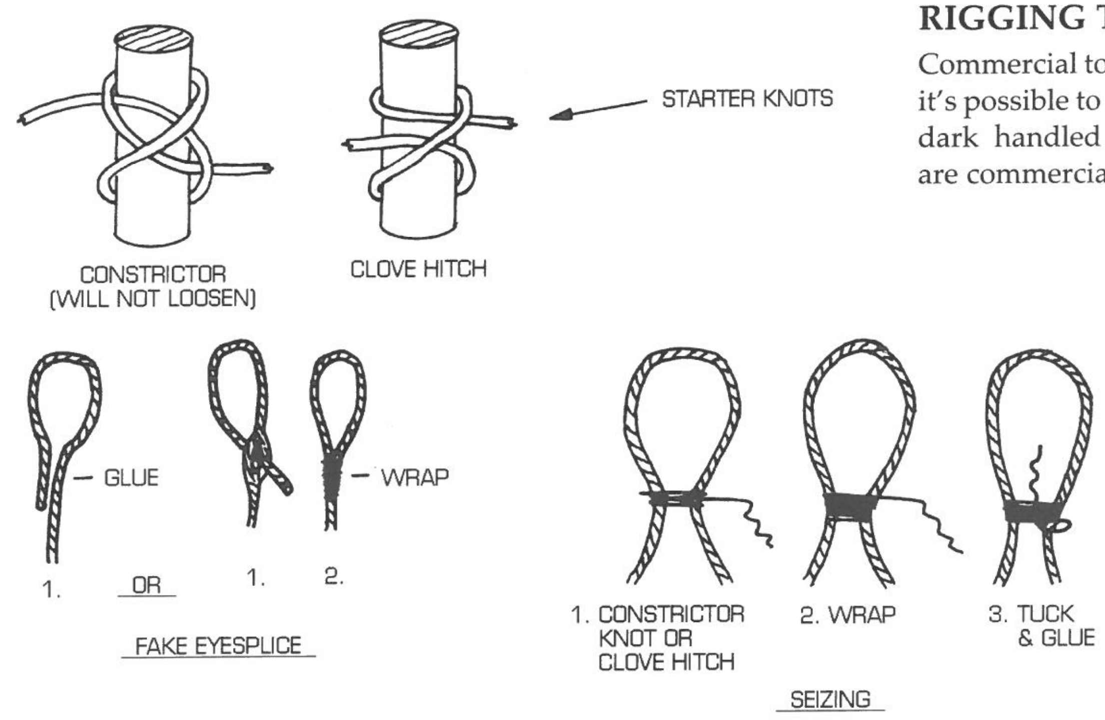

STARTER KNOTS
CONSTRICTOR (WILL NOT LOOSEN)
CLOVE HITCH
GLUE
WRAP
1.
OR
1.
2.
FAKE EYESPLICE
1. CONSTRICTOR KNOT OR CLOVE HITCH
2. WRAP
3. TUCK & GLUE
SEIZING

FIG. 6-2 – SEIZINGS & FAKE EYESPLICES

and-pull ends. In the center is a needle. Its eye was opened with a file to form a hook. Next to it is a brass rod. One end is flattened and a groove sawed in for pushing a line. A long brass rod is soldered to the pin vise. This tool is useful for drilling overlooked holes. Furthermore, the chuck accepts various bent rods and shapes. A quality scissors, one that cuts crisp and clean, is crucial. Buy one at a fabric shop. Xuron's 410T high precision shear and #440 PET high precision scissors are designed specifically for cutting in restricted areas. These are first-rate tools.

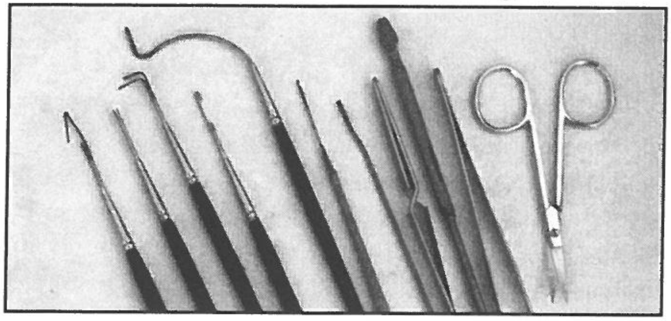


FIG. 6-4 - RIGGING TOOLS

BLOCKS, HEARTS, BULLSEYES, AND DEADEYES

Many kits substitute deadeyes for bullseyes. If so, ream its center to a single hole. The largest hearts are usually laser- or die-cut. Cut or file the stropping groove around the heart, and round the inside hole a bit.

Many of the kit supplied blocks are not shaped very well. The ends are more square than rounded. Take the time to file or sand the ends of these blocks to a more accurate shape. Also, the block may be too thick.

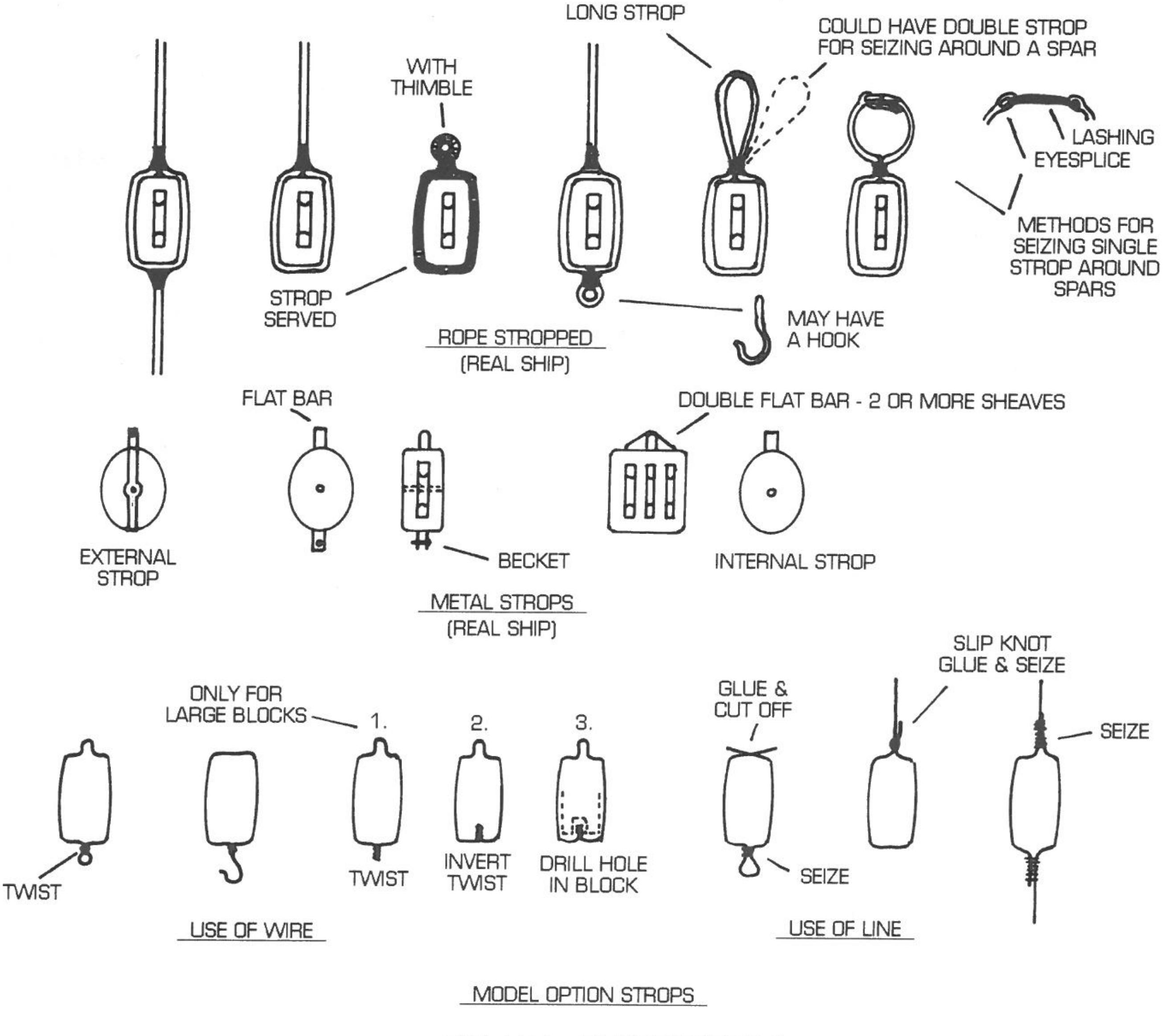

LONG STROP
COULD HAVE DOUBLE STROP FOR SEIZING AROUND A SPAR
WITH THIMBLE
LASHING
EYESPLICE
METHODS FOR SEIZING SINGLE STROP AROUND SPARS
STROP SERVED
MAY HAVE A HOOK
ROPE STROPPED (REAL SHIP)
FLAT BAR
DOUBLE FLAT BAR - 2 OR MORE SHEAVES
EXTERNAL STROP
BECKET
INTERNAL STROP
METAL STROPS (REAL SHIP)
SLIP KNOT GLUE & SEIZE
ONLY FOR LARGE BLOCKS
1.
2.
3.
GLUE & CUT OFF
SEIZE
TWIST
TWIST
INVERT TWIST
DRILL HOLE IN BLOCK
SEIZE
USE OF WIRE
USE OF LINE
MODEL OPTION STROPS

FIG. 6-5 – BLOCK STROPS

Often, these can be sanded down to a proper width.

Most blocks are *stropped* (encircled with rope or iron straps depending on the time frame). Blocks smaller than 1/4" (6mm) long are difficult to strop. Figure 6-5 shows details of real ship strops and model alternatives. If scale permits, try your best to emulate the genuine article. Stropping isn't as hard as it looks, and the results will really perk up your rigging.

SAILMAKING

Choosing the proper material is critical. Sailcloth for models must be lightweight, yet fairly opaque. Although linen is ideal, most is too heavy for small scale models, so select tightly woven cotton fabric.

Wash the sailcloth several times to preshrink it. When dry, iron the fabric, but be careful not to scorch it. Lightly pencil in seams, *tabling* (hem) lines, and other reinforcements, then sew the seams using light tan cotton thread. A sewing machine makes fast work of the project. Practice on scrap fabric and balance the needle thread tension so it doesn't pucker the material. Stitch lines to represent reinforcement patches (Figure 6-6).

When done, iron the sails. Be careful not to scorch them. Next, cut the sail shape using Line A in Figure 6-6. Fold the hem, iron it flat, and sew as close to Line B as possible. Tuck the ends and hand stitch the corners. The sail is ready for stretching.

STRETCHING SAILS

This assures the sail's proper shape, since sewing may have altered it. Using the original pattern, trace the sail's outline onto a piece of paper. Place the paper on a solid but porous backing, such as a wood or cork board. Now wash the sail again and lay it over the outline. Stretch the wet material to the sail's outline's, then secure with stick pins through its outer edges. When dry, the sail will have resumed its proper shape. Iron it one more time.

BOLTROPES AND REEF POINTS

Although *boltropes* (rope sewed to the edge of a sail to give it strength and prevent the fabric from ripping) can be omitted on 1/8" (1:96) scale models or smaller, they add immeasurably to larger ones. Figure 6-7 shows the correct way to sew boltropes and install reef points.

SEWING AIDS

Visit a fabric shop and purchase a squeeze bottle of *Fray-Chek*, a light adhesive. Running or brushing a bead along the edge of a sail prevents the material from unraveling. Do this before attempting to roll the hem. Painting Fray-Chek on untreated fabric

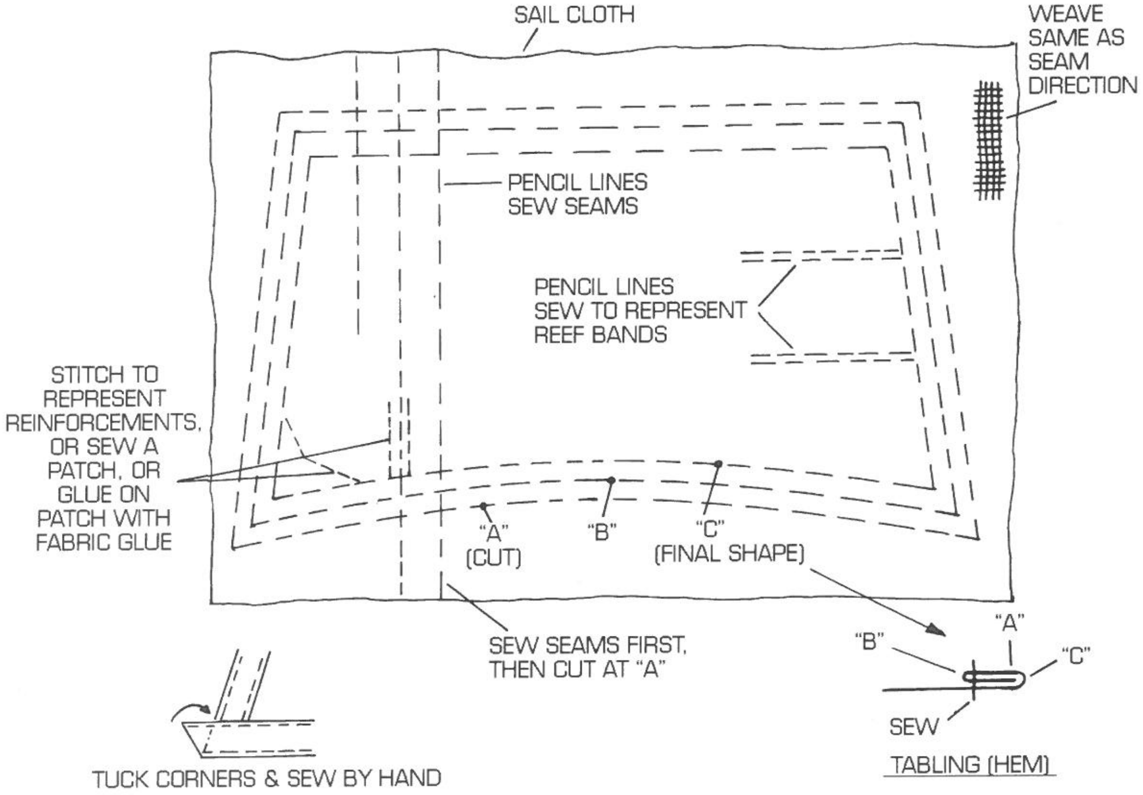

SAIL CLOTH
WEAVE SAME AS SEAM DIRECTION
PENCIL LINES SEW SEAMS
PENCIL LINES SEW TO REPRESENT REEF BANDS
STITCH TO REPRESENT REINFORCEMENTS, OR SEW A PATCH, OR GLUE ON PATCH WITH FABRIC GLUE
"A" (CUT)
"B"
"C" (FINAL SHAPE)
SEW SEAMS FIRST, THEN CUT AT "A"
"B"
"A"
"C"
SEW
TABLING (HEM)
TUCK CORNERS & SEW BY HAND

FIG. 6-6 – MAKING SAILS

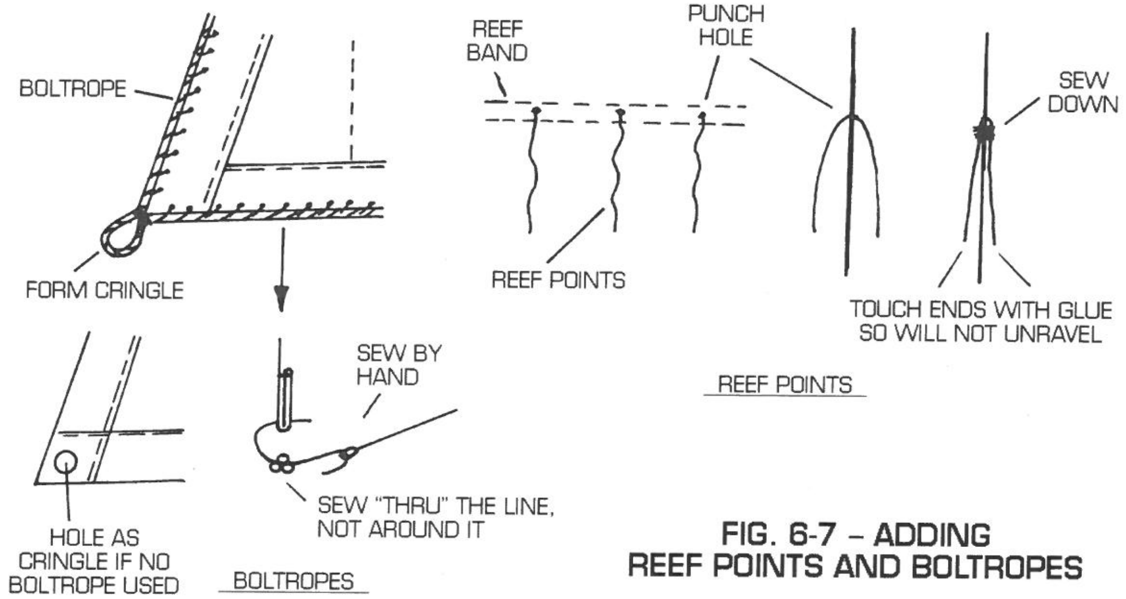

BOLTROPE
FORM CRINGLE
HOLE AS CRINGLE IF NO BOLTROPE USED
SEW BY HAND
SEW "THRU" THE LINE, NOT AROUND IT
BOLTROPES
REEF BAND
PUNCH HOLE
SEW DOWN
REEF POINTS
TOUCH ENDS WITH GLUE SO WILL NOT UNRAVEL
REEF POINTS

FIG. 6-7 – ADDING REEF POINTS AND BOLTROPES

makes cutting easier and produces a crisp edge.

Stitch-Witchery and *Wonder-Under* are heat-fusing bonding tapes that resemble thin mat fiberglass. Stitch-Witchery comes in a roll and is bond-sensitive on both sides. To join two clothes, simply place a strip between them and iron. Wonder-Under comes in sheets with a thin paper backing on one side. It's useful for bonding letters and numbers to a scale sailboat's sail. First, buy the colored fabric for the numbers. Place the Wonder-Under sheet on the cloth with the paper backing up. Iron the sheet to bond it to the fabric. Next, cut out the letters, numbers, logo, or whatever with scissors or a sharp blade. Peel off the paper backing, position the letter on the sail, and iron. This technique also works for making flags from colored fabric.

FURLING SAILS

A sail cut to the original's scale size is impossible to furl. The fabric is usually too heavy, resulting in a bulky furled sail. To solve this problem, either buy a lighter material such as *Silkspan* (model airplane covering tissue) or proportionally reduce the size of a sail by one-third when using sailcloth (Figure 6-8). Depending on their size, even Silkspan sails may require reducing by one-third. Test the percentage reduction to determine how much fabric is needed for a tight furl. Don't forget to add some seams and hems, for these details are visible even on furled sails.

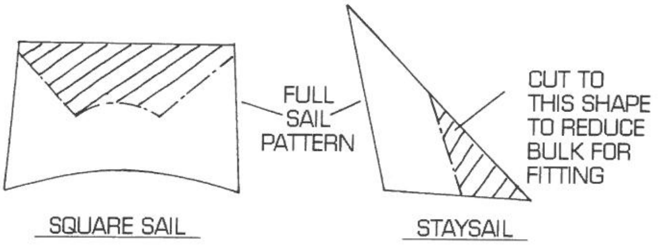

FULL SAIL PATTERN
CUT TO THIS SHAPE TO REDUCE BULK FOR FITTING
SQUARE SAIL
STAYSAIL

FIG. 6-8 – SAIL SHAPES FOR FURLING

Note: Some ship model suppliers sell Silkspan.

PLASTIC KITS

Rigging a plastic model is identical to rigging a wooden one. However, most kits come with molded shrouds and ratlines, and occasionally molded deadeyes with lanyards. Heller's *Bounty* has lanyards and chain plates molded as part of the deadeyes. These lanyards, instead looking like a line reeving in and out through the deadeyes, is one solid chunk of plastic. Not very realistic. For a first-rate model, discard these parts and substitute individual deadeyes and lanyards. Molded shrouds and ratlines are usually out of scale, so rig them separately like on a wooden model.

RIGGING MODERN SHIPS

Modern tankers and warship models don't have much rigging, but due to their scale, any lines are light and airy. For example, models at 1:350 or 1:700 scale require 0.003″ to 0.006″ diameter lines. If cordage isn't in the kit, look in hobby stores or ask for fly tying silk at sporting goods stores. Don't use too much glue to belay lines. Blobs happen effortlessly when working in small scales, and destroy the aura of realism. Occasionally, a line belays in a hole. Drill it, insert the thread, then set it with the slightest amount of cyano.

CHAPTER 7

INSTALLING THE RIGGING

This chapter applies to wooden and plastic sailing ship models. Since there are so many variables in ship rigging, I can only hit the highlights and provide some examples of what's ahead. If your kit plans lack detail or you aren't positive the rigging is correct, then it's essential to read some rigging texts listed in Appendix A. You don't want to rig a 19th century ship with 18th century details or vice versa. For example, not many iron fittings were on board before the 19th century, so most of the rigging was rope.

STANDING RIGGING

Prior to rigging, coat lines with beeswax, sort them by diameters, and keep them handy. Use cotton, silk, polyester, or nylon thread (may or may not be contained in the kit) for seizings. Apply beeswax if the seizing thread isn't already waxed. Occasionally a seizing needs a dab of white glue or cyanoacrylate to hold it in place. Standing rigging is generally black or brown-black to represent tarred line.

Shrouds

Note: The following assumes the shrouds were installed first, then the fore and aft stays. However, one option is to install the lower shrouds and stays followed by the upper shrouds and stays. What-ever the choice, remember that the stays go over the shrouds at each masthead.

Begin the standing rigging with the lower shrouds. De-pending on the ship's design and period, the lower deadeyes may have steel

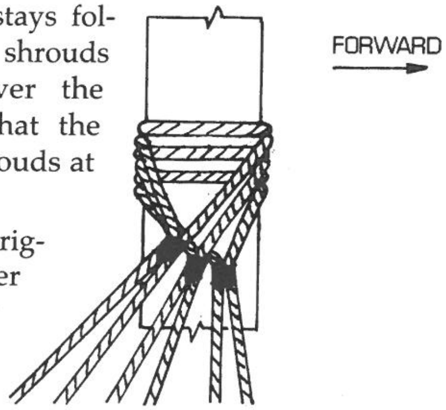


FIG. 7-2 –
STAGGERING SHROUD SEIZINGS

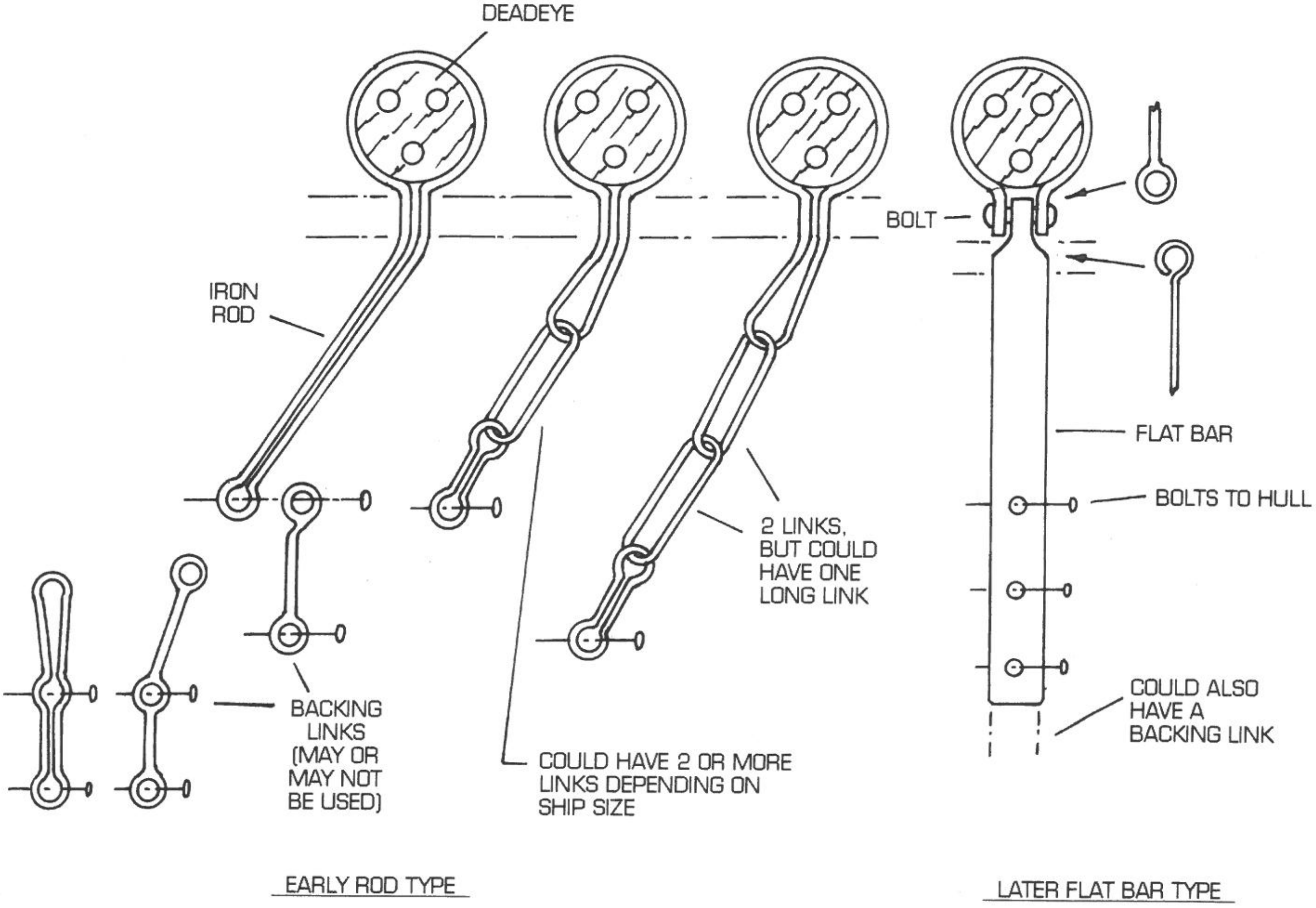

DEADEYE
BOLT
IRON ROD
FLAT BAR
BOLTS TO HULL
2 LINKS, BUT COULD HAVE ONE LONG LINK
BACKING LINKS (MAY OR MAY NOT BE USED)
COULD HAVE 2 OR MORE LINKS DEPENDING ON SHIP SIZE
COULD ALSO HAVE A BACKING LINK
EARLY ROD TYPE
LATER FLAT BAR TYPE

FIG. 7-1 – CHAINPLATES

rod or flat bar chain plates. If not supplied preformed, make the chain plates from brass strip or wire found in the kit. Figure 7-1 illustrates various deadeye and chain plate details.

Avoid piling the shroud eyes on top of the seizings. As each is applied, move the seizing back. Figure 7-2 illustrates how. If the rigging plans don't show the sequence of installing the shrouds, follow the example in Figure 7-3.

To set up the shrouds, make a temporary brass wire fixture longer than the deadeyes' final spacing (Figure 7-4). Reeving the lanyards will stretch and tighten the shrouds to the proper distance apart. Occasionally a test shroud is necessary to learn how much it stretches. Figure 7-4 also shows the sequence for reeving lanyards. When looking outboard at any deadeye, start with the knot in the upper left-hand deadeye hole. Consequently, port deadeyes have the knot aft, and starboard deadeyes have it foward. Rigging shrouds can pull the masts out of alignment, so keep an eye on them.

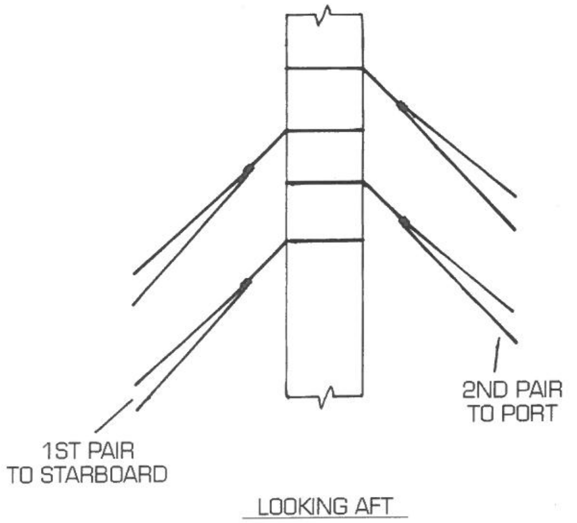

2ND PAIR
TO PORT
1ST PAIR
TO STARBOARD
LOOKING AFT

FIG. 7-3 – SHROUD SEQUENCE

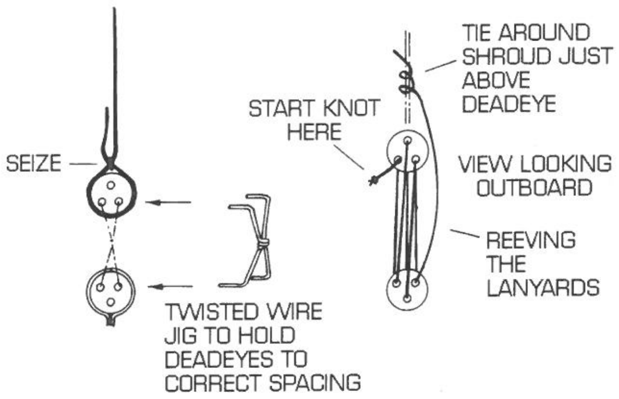

TIE AROUND SHROUD JUST ABOVE DEADEYE
START KNOT HERE
SEIZE
VIEW LOOKING OUTBOARD
REEVING THE LANYARDS
TWISTED WIRE JIG TO HOLD DEADEYES TO CORRECT SPACING

FIG. 7-4 – SPACING THE DEADEYES

Figure 7-5 shows how shrouds were *turned in* (secured) to deadeyes. All known references indicate that the most common, worldwide method was to throat seize the shroud just above the deadeye with the short end crossing over the shroud. The

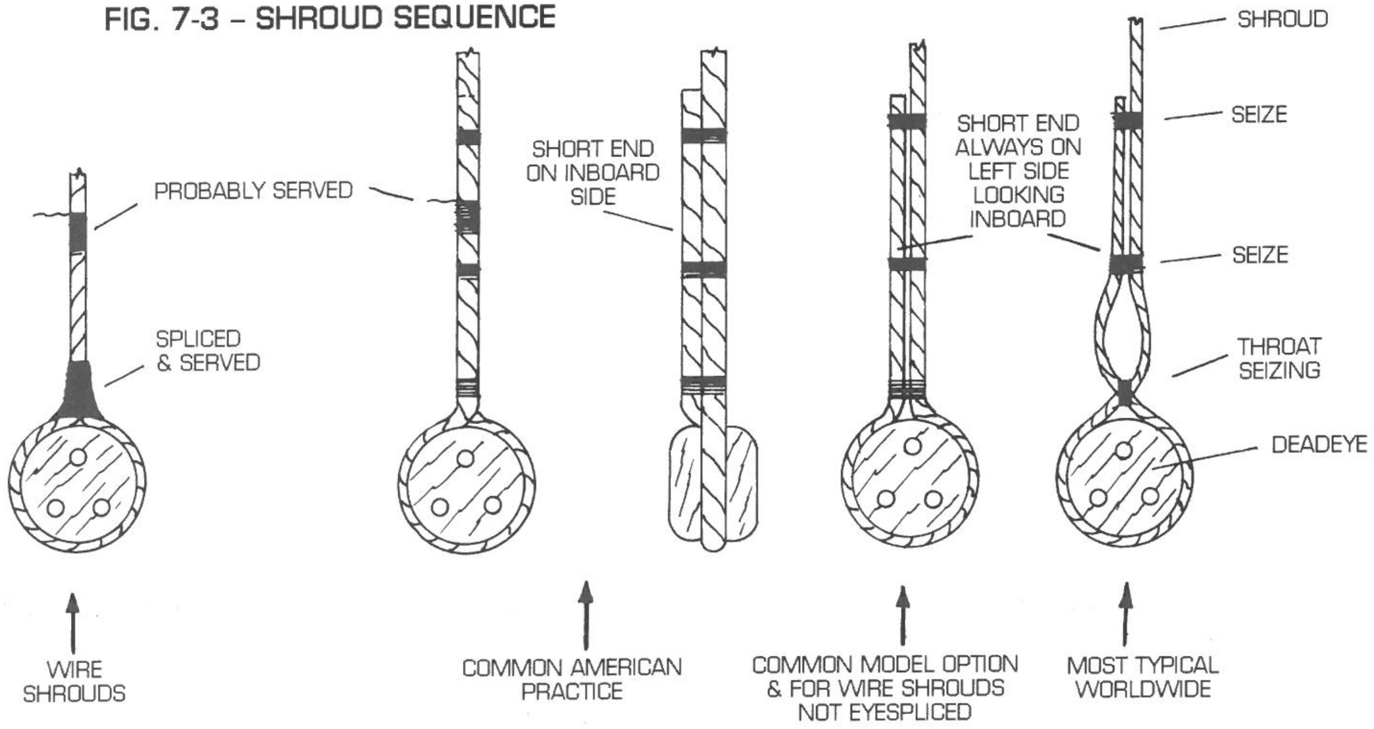

SHROUD
SEIZE
PROBABLY SERVED
SHORT END ON INBOARD SIDE
SHORT END ALWAYS ON LEFT SIDE LOOKING INBOARD
SEIZE
SPLICED & SERVED
THROAT SEIZING
DEADEYE
WIRE SHROUDS
COMMON AMERICAN PRACTICE
COMMON MODEL OPTION & FOR WIRE SHROUDS NOT EYESPLICED
MOST TYPICAL WORLDWIDE

FIG. 7-5 – RIGGING UPPER DEADEYES

illustration also shows a drawing with the short end going inboard of the shroud. This method may have been the only correct way and it apparently was common on American vessels. Another drawing illustrates a common modeling technique for seizing the shroud. Research indicates this is strictly for hemp shrouds on models. It was never used on real ships. However, it was used when wire shrouds weren't eye spliced.

Topmasts were most often rigged with deadeyes and futtock shrouds instead of chain plates. Futtock shrouds set up to lower shrouds or, on later ships, to an iron band around the mast. Depending on the ship, the topgallant shrouds could lack deadeyes and pass through the cross-trees to set up at a futtock stave. Figure 7-6 shows some futtock shroud variations.

Once the shrouds are up, mount the sheer poles if the plans call for them (some ships didn't use sheer poles). Make them from wood strip or brass rod painted black. Next, add the ratlines (Figure 7-7). For a first-rate model, use the clove hitch method if scale permits. Make sure to apply beeswax to the ratlines well before installing them. This will help the ratlines hold their slight droop. If the ratlines bow upward, tug them gently into shape. If necessary, "freeze" them to the shroud with a little cyano. Ratlines are difficult to do if tied with clove hitches. To avoid altering the spacing between shrouds, hold a group of them between your fingers while tying the knots.

Backstays

Topmast, topgallant, and royal backstays were similar to shrouds except they usually had no ratlines. Install them after the shrouds are up. Note whether the topgallant backstays use bullseyes instead of deadeyes. This depends on the particular model.

Use another fixture to set up the fore and main topmast and topgallant backstays. Their chain plates may be shorter and smaller in diameter. The royal backstay could be a running backstay with a tackle hooked to an eyebolt in the waterway. Again, follow the plans or do some research on your particular ship.

Fore and Aft Stays

Install the fore and aft stays after the shrouds and backstays are up. Be careful not to pull the masts out of line when installing the stays. Begin with the forward lower stays and work aft and upward. Depending on the type of ship and time period, fore and aft stays set up in a variety of ways. Most foremast stays rove to the bowsprit, jibboom, and flying jibboom. Figure 7-8 illustrates some stay rigging. If the plans lack detail, consult the rigging books listed in Appendix A.

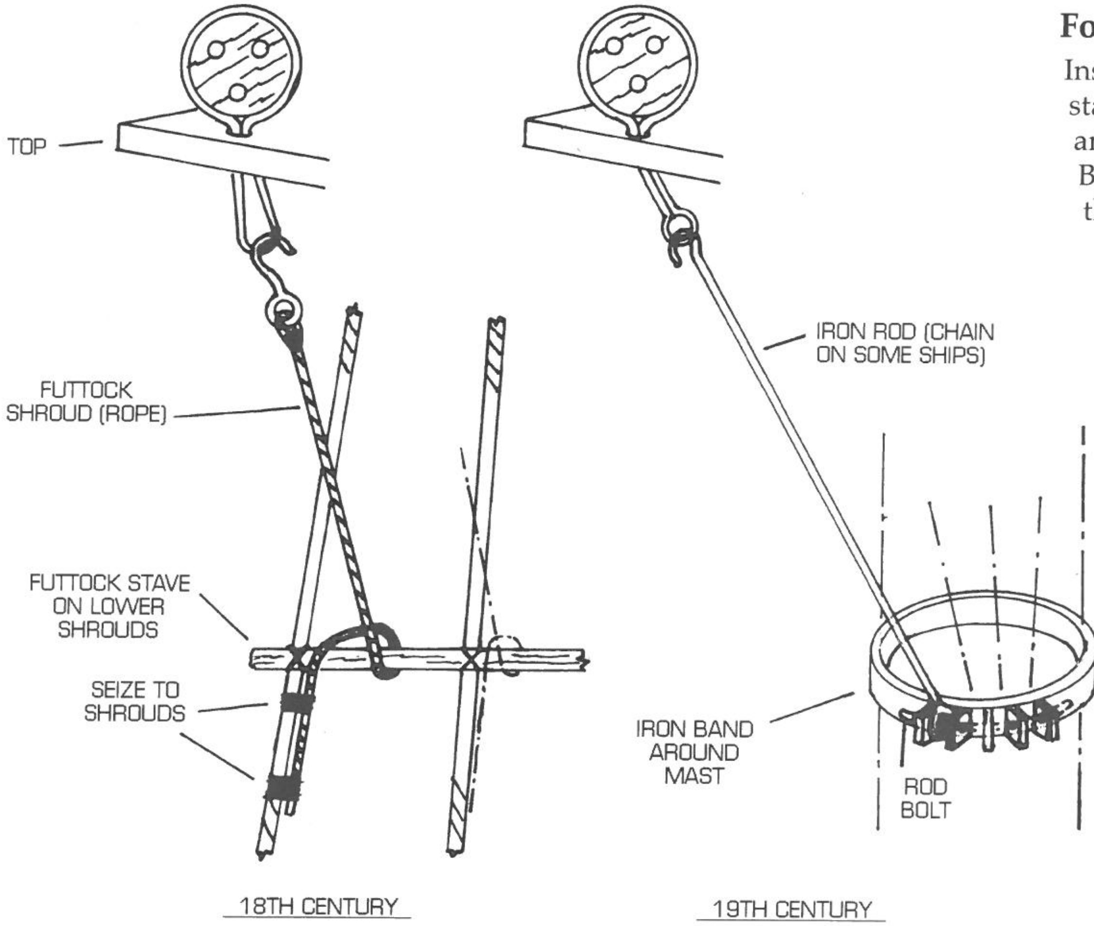


FIG. 7-6 – FUTTOCK SHROUDS

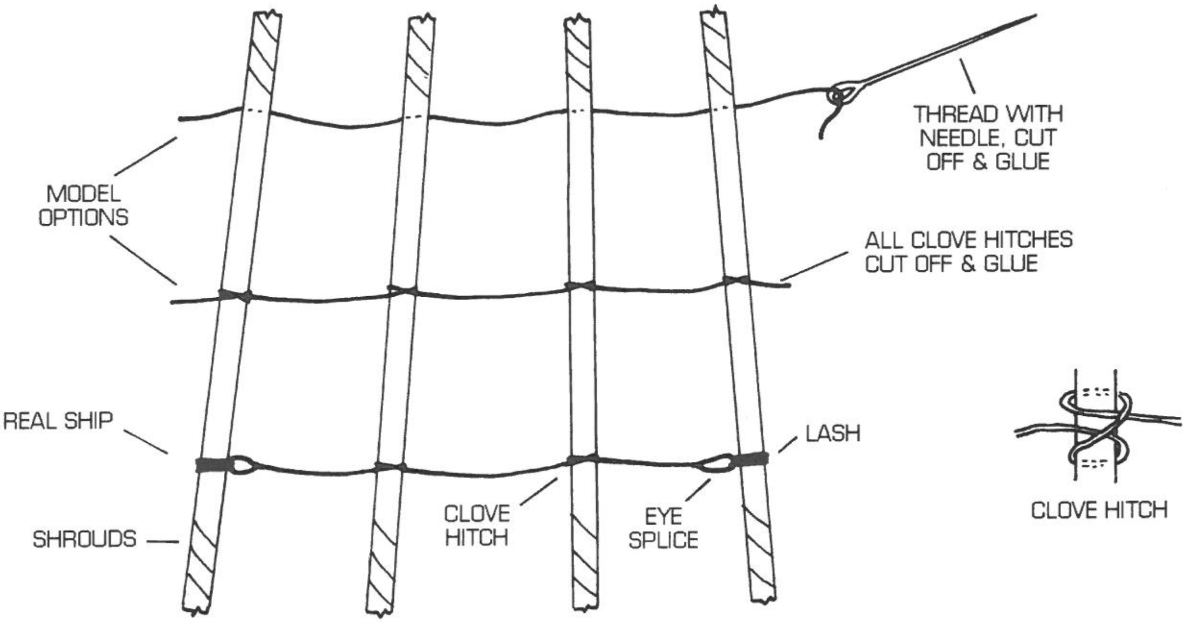

THREAD WITH NEEDLE, CUT OFF & GLUE
MODEL OPTIONS
ALL CLOVE HITCHES CUT OFF & GLUE
REAL SHIP
LASH
CLOVE HITCH
SHROUDS
CLOVE HITCH
EYE SPLICE

FIG. 7-7 – RIGGING RATLINES

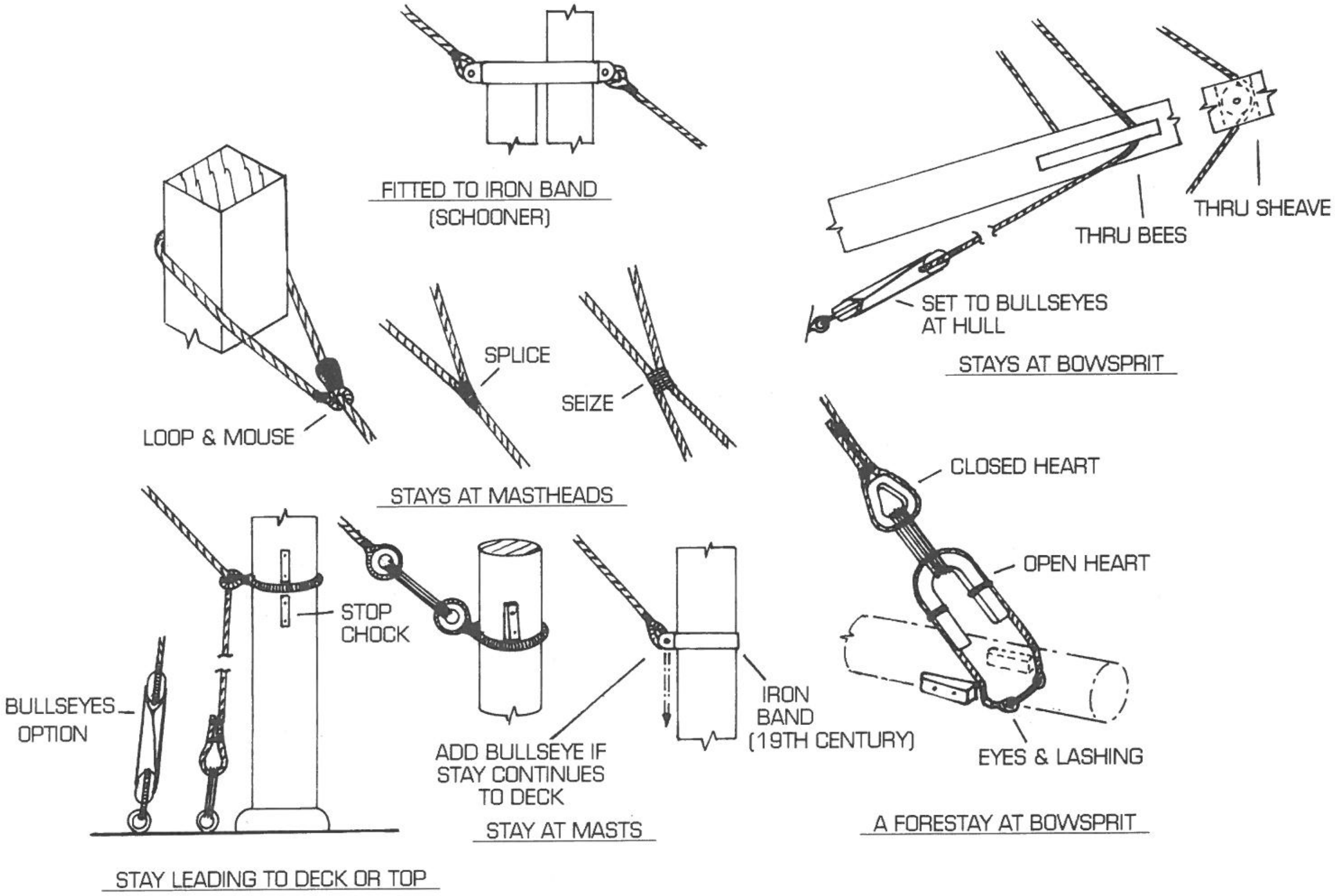

FITTED TO IRON BAND (SCHOONER)
THRU BEES
THRU SHEAVE
SET TO BULLSEYES AT HULL
STAYS AT BOWSPRIT
SPLICE
SEIZE
LOOP & MOUSE
STAYS AT MASTHEADS
CLOSED HEART
OPEN HEART
STOP CHOCK
BULLSEYES OPTION
IRON BAND (19TH CENTURY)
EYES & LASHING
ADD BULLSEYE IF STAY CONTINUES TO DECK
STAY AT MASTS
A FORESTAY AT BOWSPRIT
STAY LEADING TO DECK OR TOP

FIG. 7-8 – RIGGING FORE & AFT STAYS

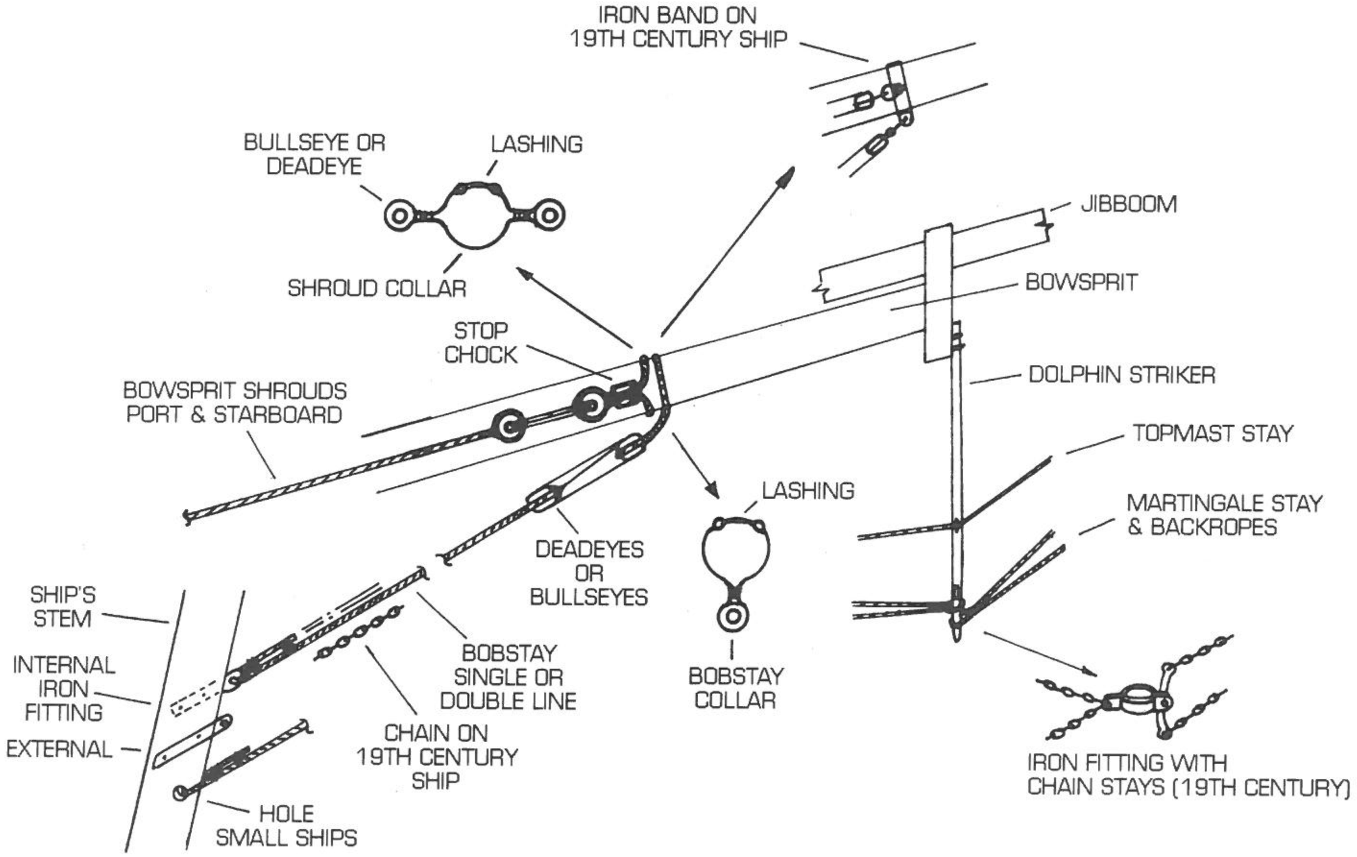

IRON BAND ON
19TH CENTURY SHIP
BULLSEYE OR
DEADEYE
LASHING
SHROUD COLLAR
JIBBOOM
BOWSPRIT
STOP
CHOCK
BOWSPRIT SHROUDS
PORT & STARBOARD
DOLPHIN STRIKER
TOPMAST STAY
LASHING
MARTINGALE STAY
& BACKROPES
DEADEYES
OR
BULLSEYES
SHIP'S
STEM
INTERNAL
IRON
FITTING
EXTERNAL
BOBSTAY
SINGLE OR
DOUBLE LINE
BOBSTAY
COLLAR
CHAIN ON
19TH CENTURY
SHIP
HOLE
SMALL SHIPS
IRON FITTING WITH
CHAIN STAYS (19TH CENTURY)

FIG. 7-9 – SOME BOWSPRIT RIGGING DETAILS

Bowsprit Rigging

In addition to the stays mentioned above, bowsprits are fitted with bobstays, martingale stays, backropes, and bowsprit shrouds. Most lines set up on the hull or to catheads with eyebolts and deadeyes or bullseyes (Figure 7-9).

Nineteenth century ships generally had chain bobstays and possibly chain martingales secured to iron bands with shackles. One modeling technique for achieving a taut chain is to install it using a long link (Figure 7-10). This allows some leeway when tightening the chain. Check the size of the chain against the plans, or from a rigging text. Many kits supply chain too heavy for the model (42-links-per-inch is the smallest available). Biddlecombe gives sizes of rigging lines for various rigs, but also has a table of equivalent chain sizes that is useful for determining scale chain rigging sizes. It's unlikely small enough chain is available for small scale models, so use the smallest chain you can find. Look in jewelry stores and jewelers' catalogs.

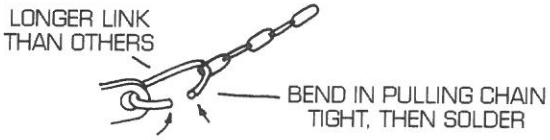

LONGER LINK
THAN OTHERS
BEND IN PULLING CHAIN
TIGHT, THEN SOLDER

**FIG. 7-10 –
LONG LINK TO TIGHTEN CHAIN**

Footropes and Fixed Lifts

It's easier to install footropes and the ends of fixed lifts with their spars in hand. Footropes, like ratlines, may require gentle persuasion before they droop naturally. Check every line before proceeding to the running rigging. If necessary, touch up shiny glue on seizings with black paint or liquid shoe polish.

Al Caunitz did an excellent job rigging Model Shipways' *Flying Fish* (Figure 7-11) This is a first-rate model of a clipper ship.

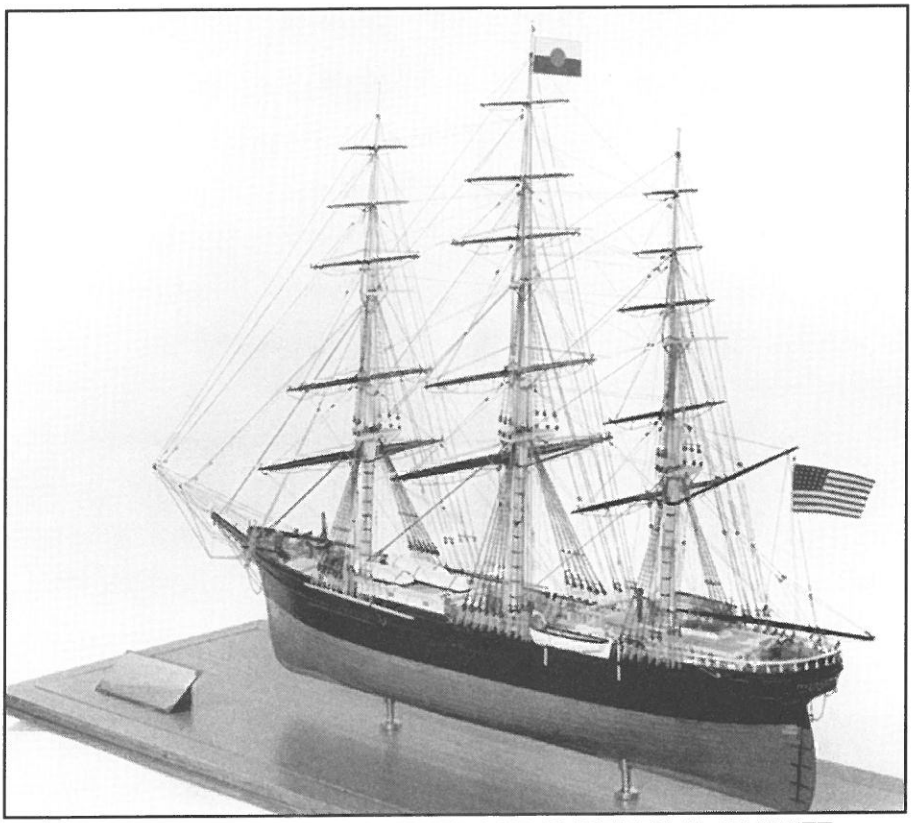


FIG. 7-11 - FLYING FISH MODEL AND PHOTO BY AL CAUNITZ

Rig With No Sails: Attach the halliard to the downhaul and bring it down to the end of the bowsprit.

Figure 7-13 illustrates a typical jib rig. Halliard runs are identical to a rig with sails except for the location of the head block. Remove the sheets with their sails. Sheets were sometimes left on deck, but this would clutter up a model. Hanks, too, could be left on the stay, but it's better to omit them.

Rig With Furled Sails: Figure 7-14 illustrates a furled outer jib and flying jib. Notice how little the bundle is above the booms. Also, the hanks are together, not separated. This is why I recommended reducing the amount of sailcloth by one-third or using Silkspan (see Chapter 6). Pulling up the halliard will loosen the furl, but this could affect the model's realism. Less is better when it comes to sails.

SAILS AND RUNNING RIGGING

It is now decision time. Will you rig with sails, rig without, or settle somewhere in between? The following discusses these choices and how to rig them. Each sail and its spars are presented separately. So, finish one sail group before moving to the next. The sequence is not critical, but I recommend starting at the bow with the fore and aft sails, then adding the square sails. Seize all blocks in place before adding the sails and their rigging.

Fore Staysails

For simplicity, a fore staysail, inner and outer jibs, and flying jib were generally called head sails. Add halliards, downhauls, and sheets to the sails before installing on the model. After reeving through the various blocks, leave enough line for belaying. Coil the line at the belaying point like on a real ship (Figure 7-12), or belay the line and add a separate coil. The second option is easier.

Many ships had wooden hanks for bending the head sails to the stays. For small scale models, duplicate these with a split brass rings (may be provided in the kit). Pull the sheets taut on the side the sail is on. Drape the other side loosely over the stays to its standing-end eyebolt and running-end belaying point.

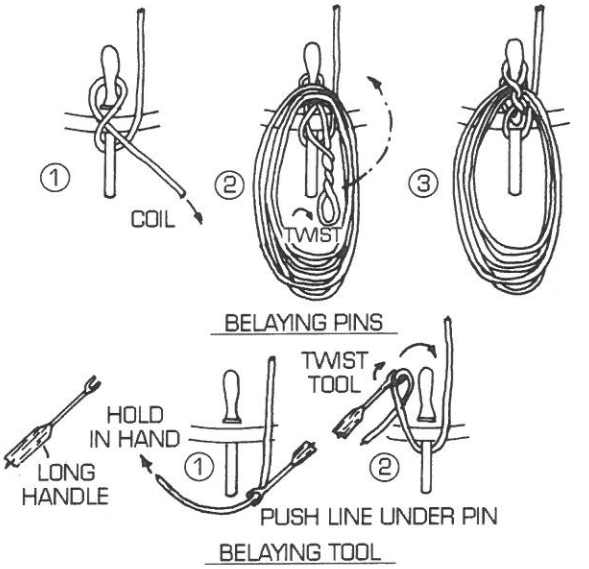


FIG. 7-12 - BELAYING LINES

Main and Mizzen Staysails

Staysails between the fore, main, and mizzenmasts were rigged with hanks, downhauls, halliards, and sheets. Topgallant staysails may have a tack fitted with a thimble coming down from the top of the sail. The topmast staysail tack often reeves through a fairlead on the downward part of the topmast stay and belays to the deck. Check your plan and refer-

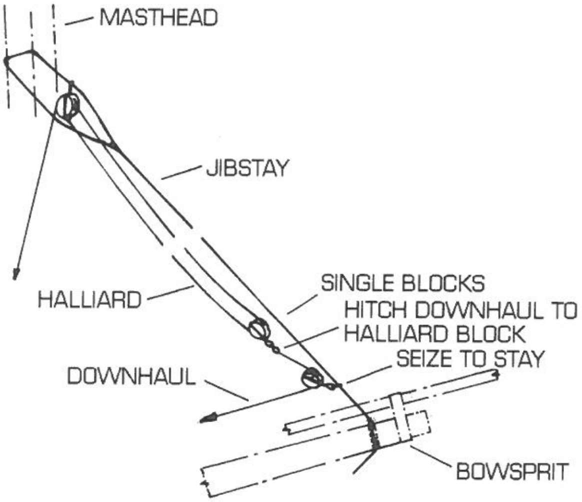

MASTHEAD
JIBSTAY
HALLIARD
SINGLE BLOCKS
HITCH DOWNHAUL TO HALLIARD BLOCK
SEIZE TO STAY
DOWNHAUL
BOWSPRIT

FIG. 7-13 – RIGGING A JIB HALLIARD & DOWNHAUL WITHOUT SAIL

ences for these leads.

If no sails are included, omit their sheets and tacks, but hook the downhauls and halliards together.

Spankers and Other Gaff Sails

On some ships, a single lift held the spanker gaff aloft, and the sail could be furled only by brailing toward the mast. Other spankers and a gaff sail were hoisted and lowered via throat and peak halliards. They could be furled between the boom and gaff (like on a fishing schooner which did not use brails) or brailed on a ship with such a rig.

For either rig, do as much work as possible with the boom and gaff in hand. The most difficult task if sails are being fitted is sewing the mast hoops to the sail. This is best done with the sail off the model, but if you already have the upper masts in place the task must be done on the model. If mast hoops are included in the kit, they are supplied as laser-cut wood fittings, castings, or brass rings. If none are provided, don't worry. Realistic mast hoops are easy and fun to make (Figure 7-15).

Reeve all the lines, but leave them loose. First set the boom sheet, then tighten the peak and throat halliards if they are required. Fit the brails (spanker), then the topping lifts and vangs if there are any. Add the flag halliard after making a flag. Topping

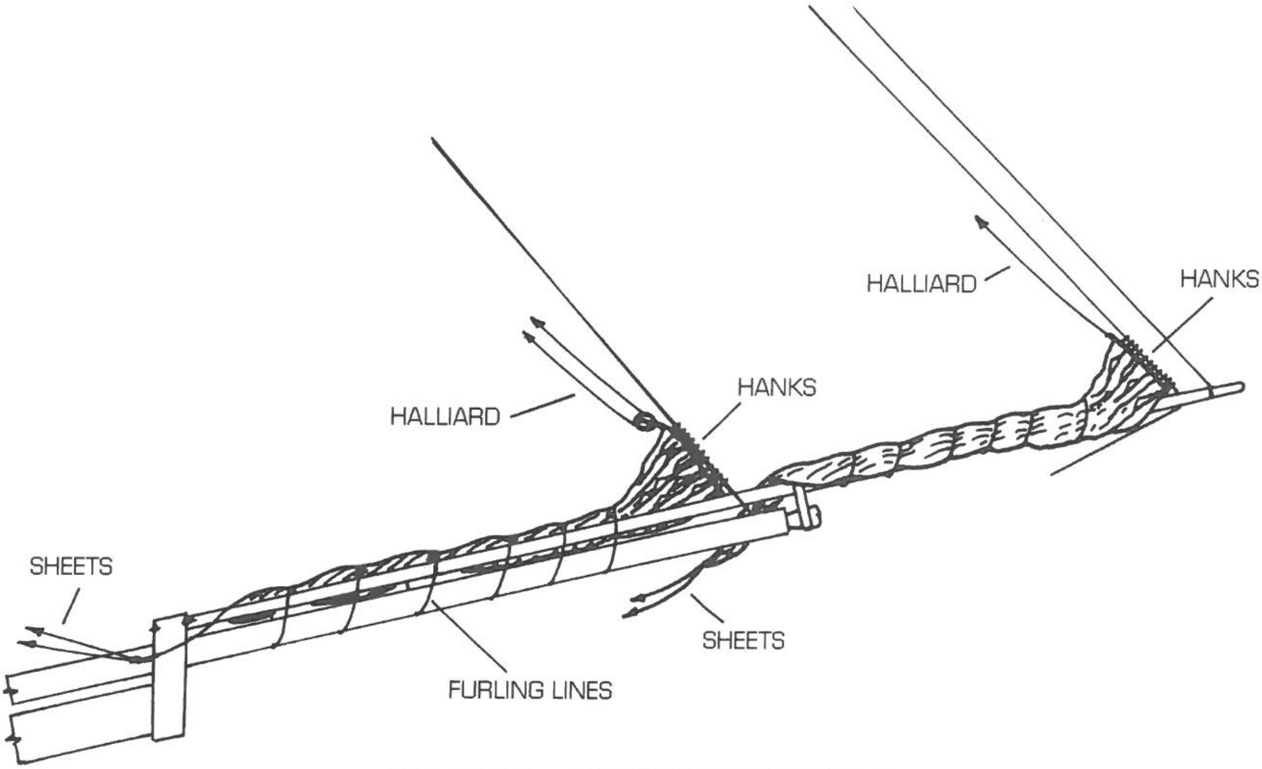

HALLIARD
HANKS
HALLIARD
HANKS
SHEETS
SHEETS
FURLING LINES

FIG. 7-14 – FURLED HEAD SAILS

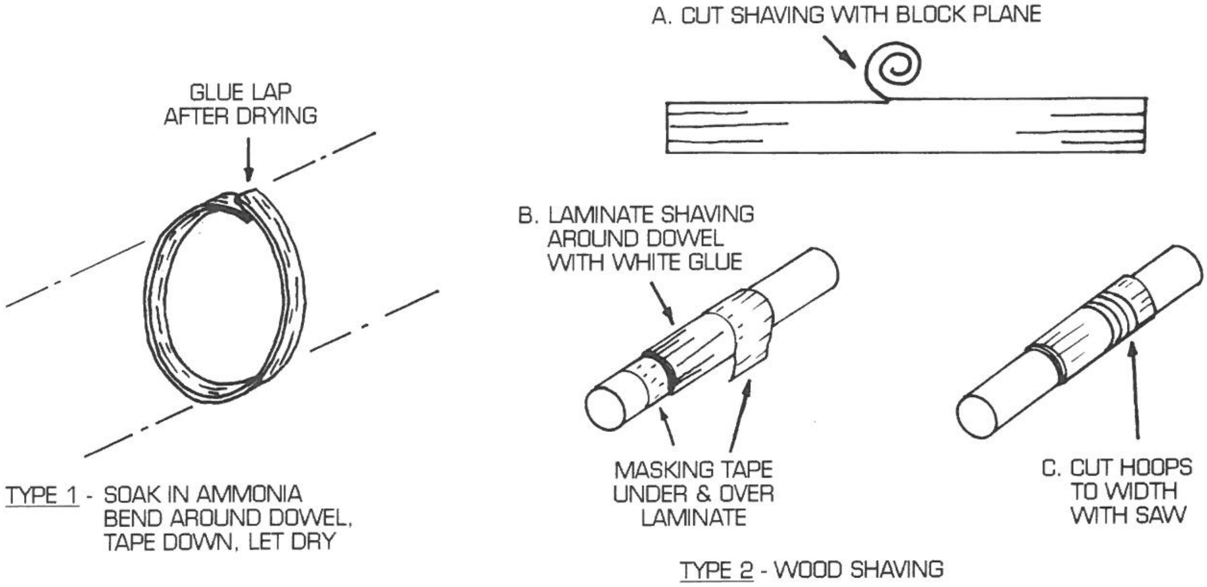
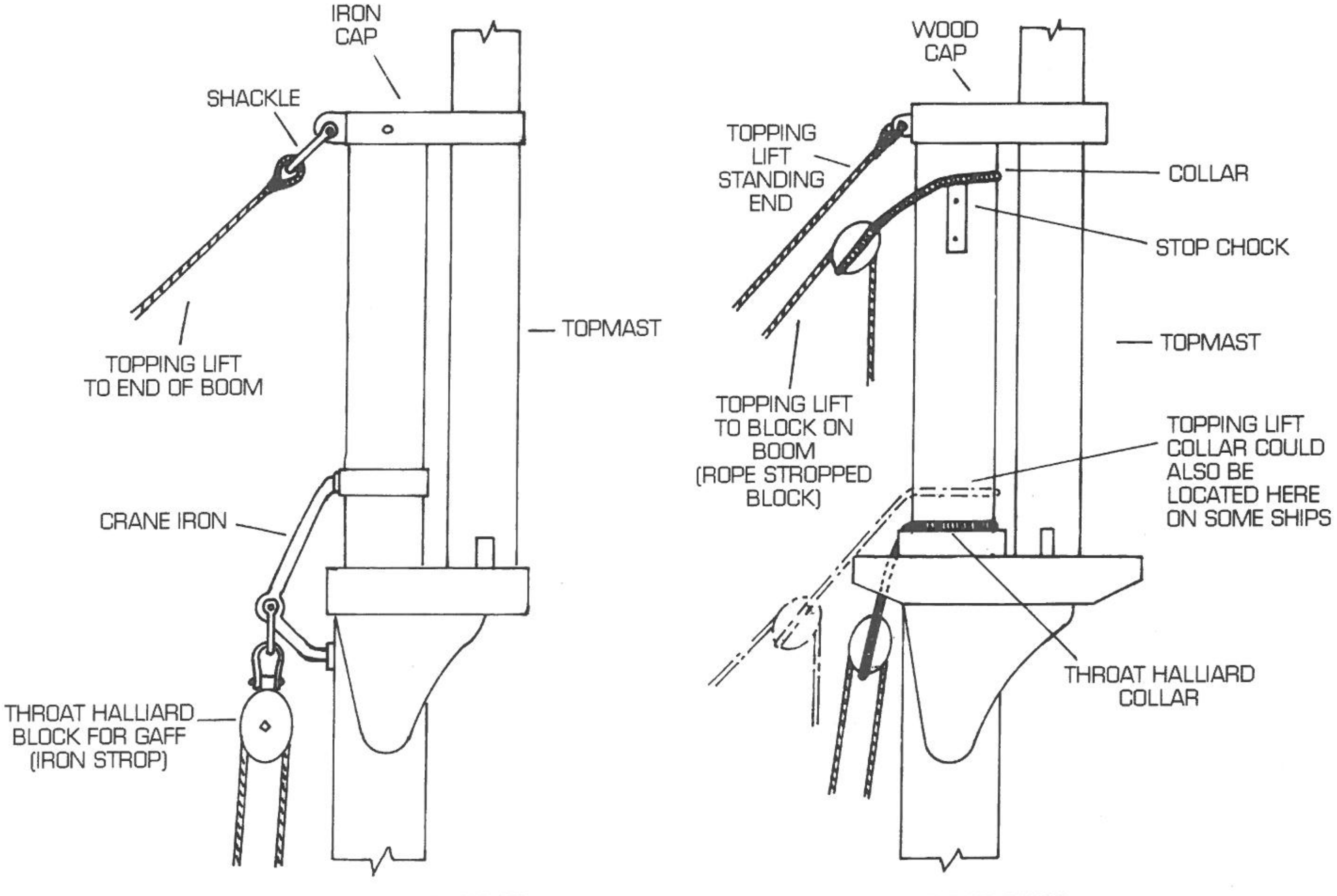

GLUE LAP AFTER DRYING
TYPE 1 - SOAK IN AMMONIA BEND AROUND DOWEL, TAPE DOWN, LET DRY
A. CUT SHAVING WITH BLOCK PLANE
B. LAMINATE SHAVING AROUND DOWEL WITH WHITE GLUE
MASKING TAPE UNDER & OVER LAMINATE
C. CUT HOOPS TO WIDTH WITH SAW
TYPE 2 - WOOD SHAVING

FIG. 7-15 – MAST HOOPS


IRON CAP
SHACKLE
TOPMAST
TOPPING LIFT TO END OF BOOM
CRANE IRON
THROAT HALLIARD BLOCK FOR GAFF (IRON STROP)
WOOD CAP
TOPPING LIFT STANDING END
COLLAR
STOP CHOCK
TOPMAST
TOPPING LIFT TO BLOCK ON BOOM (ROPE STROPPED BLOCK)
TOPPING LIFT COLLAR COULD ALSO BE LOCATED HERE ON SOME SHIPS
THROAT HALLIARD COLLAR

1902 FISHING SCHOONER

EARLY BRIG OR SLOOP

FIG. 7-16 – VARIATIONS IN TOPPING LIFT & THROAT HALLIARD RIGGING

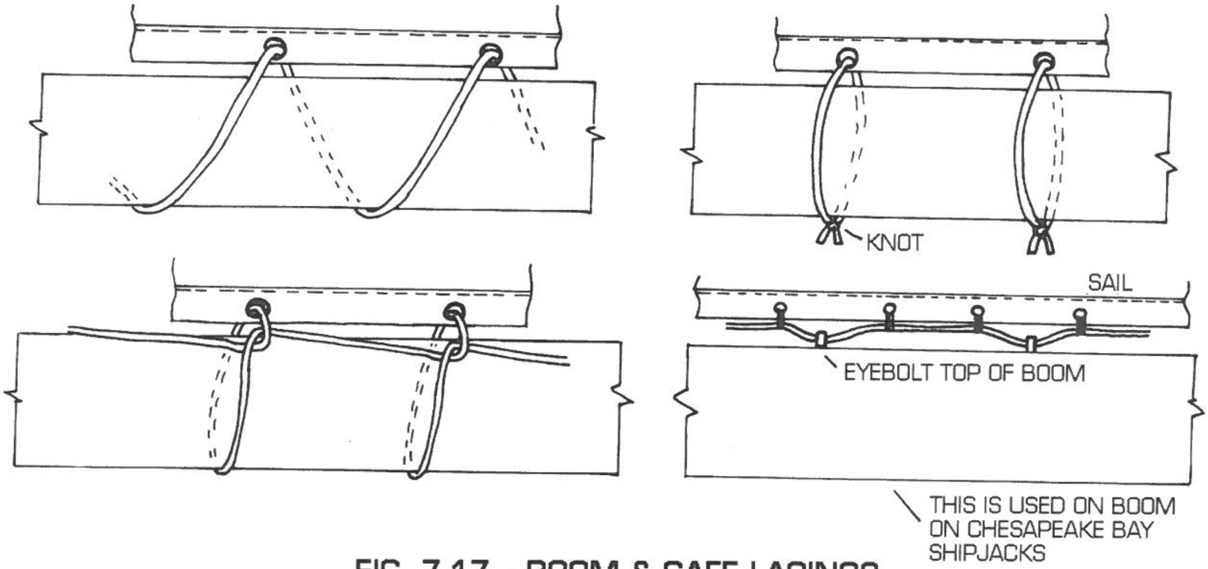

KNOT
SAIL
EYEBOLT TOP OF BOOM
THIS IS USED ON BOOM ON CHESAPEAKE BAY SHIPJACKS

FIG. 7-17 – BOOM & GAFF LACINGS

lifts and throat halliards may have collars at the mast head or set to crane irons and iron bands. Again, the period and ship type determine what is used. Figure 7-16 shows the extreme differences.

The spanker and gaff sail are laced to the gaff, and could be laced to the boom or be loose footed. If the plans don't define lacing details, refer to Figure 7-17 for some options.

Rig With No Sails: Several options exist for rigging a gaff sail with peak and throat halliards. The shipwright approach is to lower the gaff on top of the boom. Or, if you prefer, leave the gaff up. If the gaff has vangs, they will steady the spar and prevent it flopping from side to side. Some modelers prefer this position, because it fills the area aft of the mainmast. If no vangs are present, you may need to fix the gaff jaws at the mast to prevent it from flopping side to side.

Remove any brails with the sails, but install the necessary blocks on the gaff and mast hoops. Stack mast hoops in a pile at the boom. Rig topping lifts to hold up the boom as well as all other lines.

Furled Sails: Figure 7-18 illustrates a furled spanker. Note: Pull the clew up to the middle brail block at the mast. Its clew outhaul hangs back to the boom end.

Boom and Tiller Guys: These lines steadied the boom and tiller when the sails were furled or removed. However, a boom guy occasionally assisted the boom sheets in heavy weather. Include these details if appropriate.

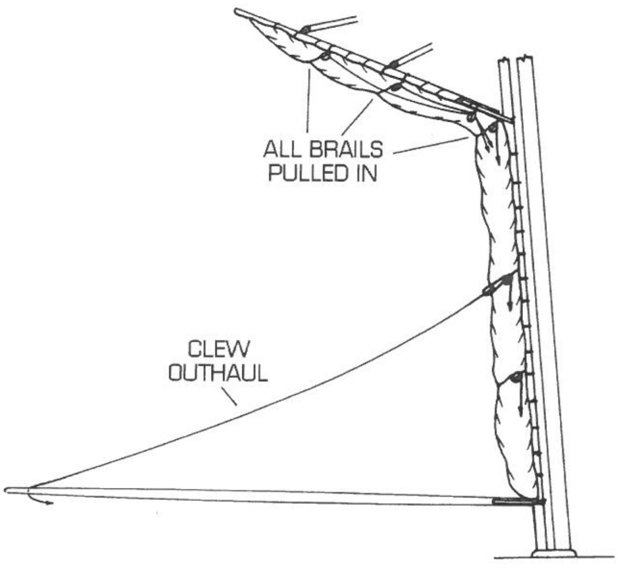

ALL BRAILS PULLED IN
CLEW OUTHAUL

FIG. 7-18 – FURLING A SPANKER

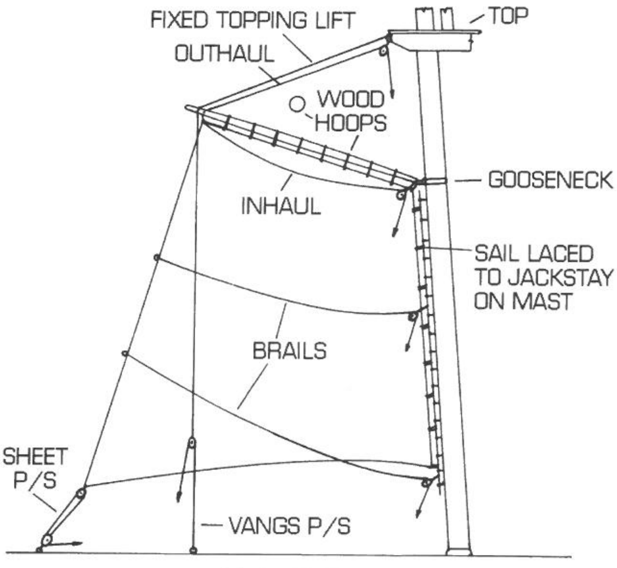

FIXED TOPPING LIFT
TOP
OUTHAUL
WOOD HOOPS
GOOSENECK
INHAUL
SAIL LACED TO JACKSTAY ON MAST
BRAILS
SHEET P/S
VANGS P/S

FIG. 7-19 –
SPENCER ON CLIPPER FLYING FISH

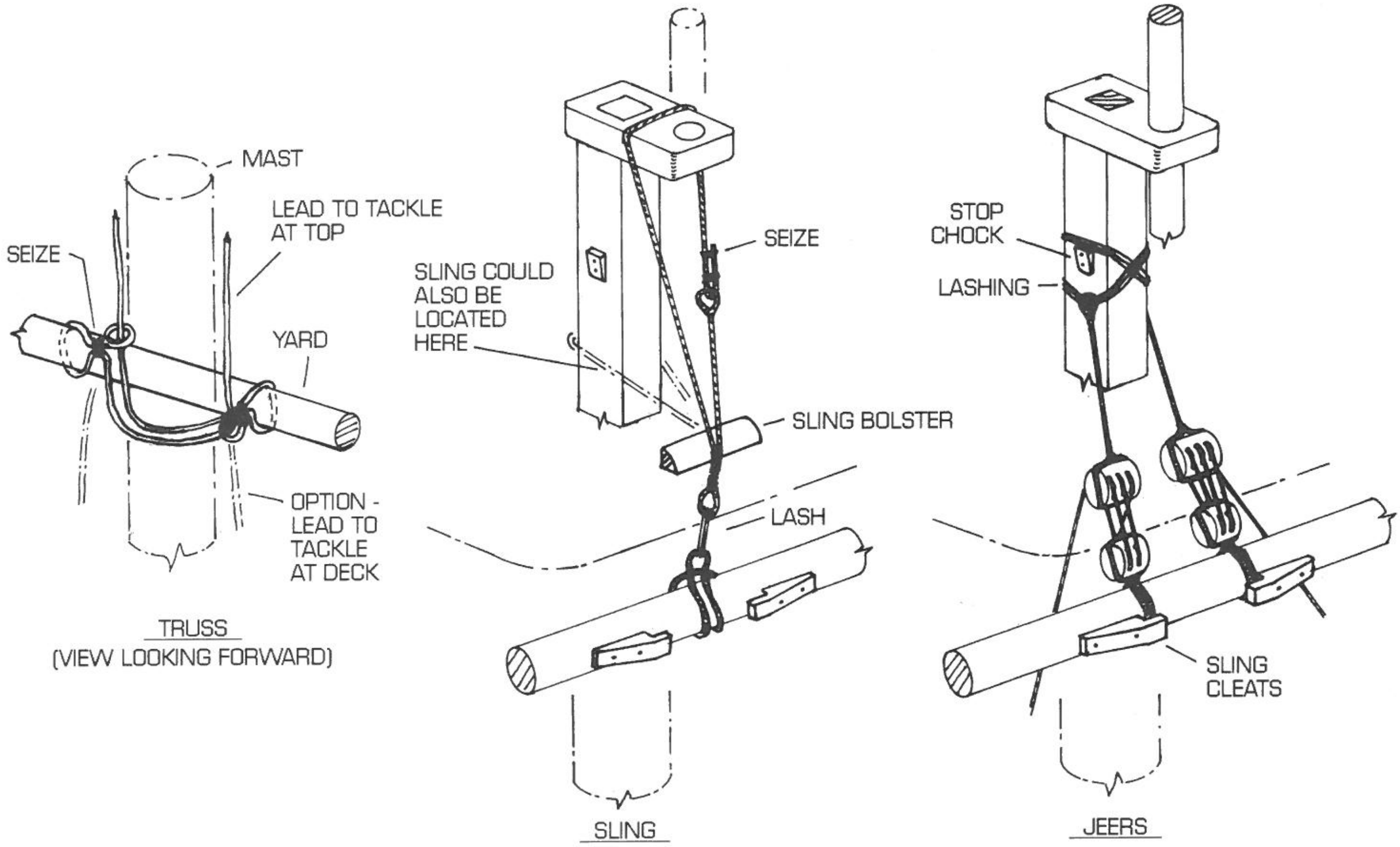

MAST
LEAD TO TACKLE AT TOP
SEIZE
YARD
OPTION - LEAD TO TACKLE AT DECK
TRUSS
(VIEW LOOKING FORWARD)
SEIZE
SLING COULD ALSO BE LOCATED HERE
SLING BOLSTER
LASH
SLING
STOP CHOCK
LASHING
SLING CLEATS
JEERS

FIG. 7-21 – COURSE YARD RIG

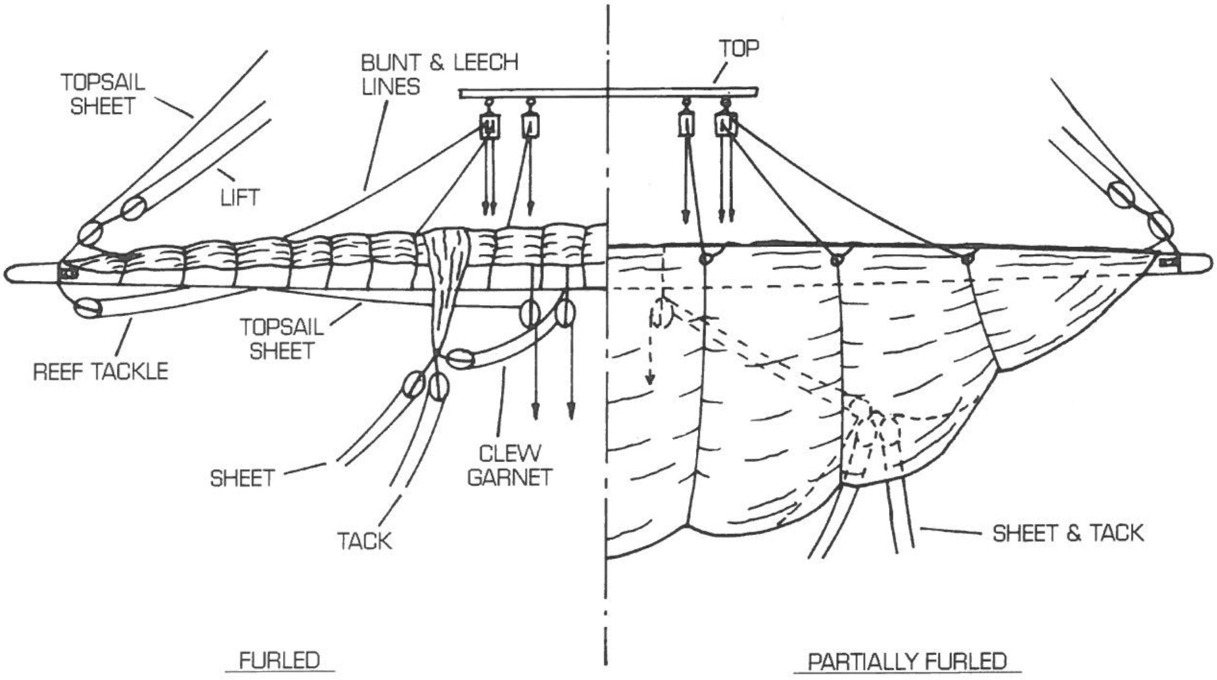

TOPSAIL SHEET
LIFT
BUNT & LEECH LINES
TOP
TOPSAIL SHEET
REEF TACKLE
SHEET
CLEW GARNET
TACK
SHEET & TACK
FURLED
PARTIALLY FURLED

FIG. 7-23 – FURLING A COURSE

Spencers

These are small loose footed fore-and-aft gaff sails abaft the fore- and mainmasts. Figure 7-19 shows a spencer sail on Model Shipways' *Flying Fish*, a clipper ship. This is an interesting sail. Notice the lack of throat and peak halliards, and that a single lift fixes the gaff. The sail is hung from the gaff with mast hoops, so the inhaul and brails will pull the entire spencer to the mast for furling.

Lower (Course and Crossjack) Yards

Mount the required blocks to their yards and reeve as many loose lines as possible. Lace the sail to the jackstays, then attach the sheets, tacks, buntlines, leechlines, and clew garnets. Footropes and yard tackles should already be on the yard. Remember, leechlines and buntlines are on the forward face of the sail; all others are aft. Rig the lifts after the yard is installed.

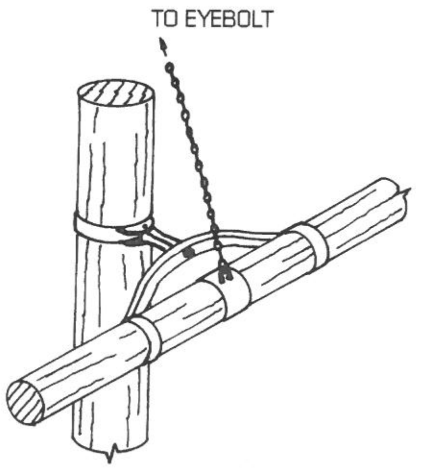


FIG. 7-20 – IRON TRUSS & SLING

A chain sling attached to an iron truss fixed to a metal band around the mast supported 19th century course yards (Figure 7-20). Older course yards hung from a sling around the mast. A tackle on the parrel (or truss) led to the deck or topside to pull the yard taut against the mast. Heavy yards also were supported and lowered to deck by jeers. Figure 7-21 illustrates an 18th century lower yard rig separated into three views to show the sling, truss, and jeers.

After installing the yard, reeve and belay its lines, then attach the braces. Most brace blocks were seized to the shrouds or tops, perhaps with a short pendant to keep the block away from the shrouds. Depending on how the model is to appear, brace the yards level and perpendicular to the centerline or at an angle.

Course sheets led outboard through sheaves in the bulwarks, then belayed to an inboard cleat. The fore course tack led to a bumpkin or, depending on the ship's design, to a belaying point. The main course tack led in a similar fashion, but not usually to a bumpkin.

Rig With No Sail: Omit the sheets and tacks with the sail, or hook them to the clew garnet and pull up to the yard. However, the latter can be clumsy. The best solution is to omit the sheets and tack and hook the clew garnet to the reef tackle. Stop off buntlines and leechlines at the yard fairleads (Figure 7-22). Another option is to omit the bunt and leechlines and just install the blocks. Or, delete the reef tackle and pull the lower clew garnet block up to the upper block.

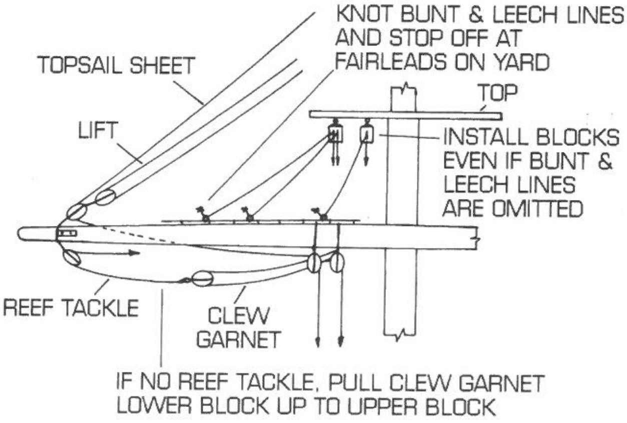

KNOT BUNT & LEECH LINES AND STOP OFF AT FAIRLEADS ON YARD
TOPSAIL SHEET
TOP
LIFT
INSTALL BLOCKS EVEN IF BUNT & LEECH LINES ARE OMITTED
REEF TACKLE
CLEW GARNET
IF NO REEF TACKLE, PULL CLEW GARNET LOWER BLOCK UP TO UPPER BLOCK

FIG. 7-22 – COURSE SAIL RIG WITH NO SAIL

Furled or Partially Furled Sail: Figure 7-23 illustrates a furled course sail and one partially pulled up by the bunt and leechlines.

Topsail Yards

Rig the topsails similar to the courses. The basic differences are in rigging sheets and lifts. With the sail bent, hoist its yard with the halliard and droop the lifts. The sheets reeve through blocks at the course yardarms.

The topsail halliards are a hefty rig with tackles in the port and starboard channels.

Rig With No Sail or Furled Sail: Figure 7-24 illustrates both approaches. In both, the yards are lowered and hang on lifts.

Topgallant and Royal Yards

Their rig is essentially the same as for the topsails, but with fewer lines.

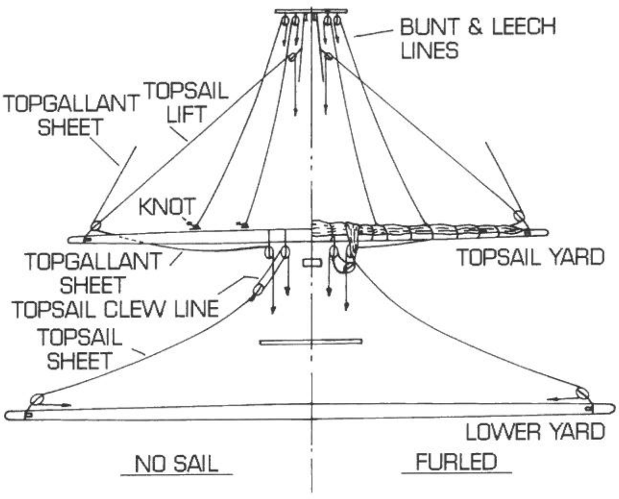


FIG. 7-24 - TOPSAIL RIGGING

Studding Sails

Many ships used studding sails, pronounced "stunsls." Most modelers don't install these overwhelming sails. However, do stow the studding sail booms on their yards, hooked into a fitting on the channels, or alongside the ship. Check the plans to see what is required. Refer to Al Caunitz's *Flying Fish* (Figure 7-11) and study his studding sail booms. In this particular ship the inboard ends are raised off the main boom. On other ships the studding sail booms may just slide inboard through boom irons.

Spritsail Yards

The spritsail yard found on most old ships had lifts and braces. The rig looks like a regular square sail but lying in a flat plane. Lifts rove to belaying pins or cleats inboard at the bow. Braces led to the foretop, then through blocks down to belaying points.

Miscellaneous Rigging

Several lines are often overlooked or ignored when rigging a model. Possibly, the plans don't show them, so they are listed below. Keep them in mind when researching your model's rig. Should they be included?

Flag Halliards: These are generally located at mast poles and ends of gaffs. A flag halliard was a single line rove through a small block. Substitute an eyebolt for the block if the correct size isn't available or it requires too much sanding to make one from a larger block.

Stay Tackles: On many older ships, tackles located above the hatches attached to the fore and main stays. These lifted cargo or boats. When not in use, tackles hooked to cleats or belaying pins (Figure 7-25).

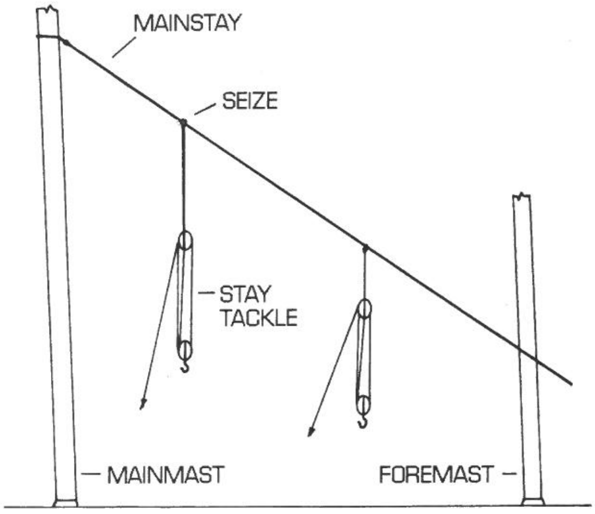


FIG. 7-25 - STAY TACKLES

Mast and Jibboom Tackles: Topmasts and topgallant/royal masts had a sheave in their heel. To lower or raise the mast, sailors fitted a tackle from the cap, through the sheave, and back to the cap. These tackles, however, were not a permanent fitting and are omitted on model plans. A similar tackle outhauled the jibboom.

Pendants for Tackles at Mastheads: Pendants were often fitted under the shrouds on old ships. A tackle hooked into them for lifting heavy objects like cannon. Models generally are fitted with pendants, but not tackle as it was portable (Figure 7-26).

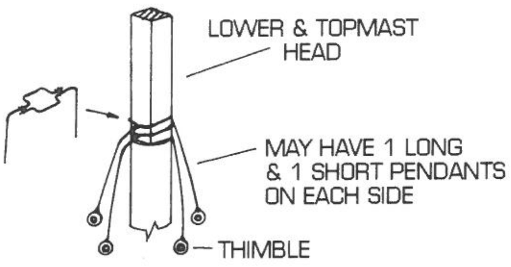


FIG. 7-26 - PENDANTS FOR TACKLES AT MASTHEADS

FINAL TOUCHES

When the model is rigged, recheck every line. Be certain seizings are sound. Add another dab of glue if they aren't. Touch up shiny spots on standing rigging with black paint or liquid shoe polish. Use a tan stain or brown liquid shoe polish for running rigging. Check if the rigging process fouled any painted wooden parts and repair them.

CHAPTER 8

MOUNTING AND DISPLAYING THE MODEL

MOUNTING

Wood ship model kits generally provide brass or wooden mounting pedestals. However, Model Shipways' *Phantom* and *Pride of Baltimore II* feature a building or launching ways. Plastic kits usually have a molded cradle. Regardless of what comes in the kit or what you choose to use, mount the model after completing its basic hull. The task is easiest now and prevents damaging the hull when handling the model. Always mount the model with the waterline, or maybe the copper line, parallel to the baseboard. Models look best if displayed like they were floating in water.

BASEBOARDS

The kit may contain a baseboard, but it's generally too small to accommodate an acrylic or glass case. However, when attached to another board of sufficient length and width, it's useable provided the wood is suitable. If not, purchase hardwood sized to the display case. Some choices are cherry (my favorite), walnut, bubinga, rosewood, mahogany, and maple. Refer back to Al Caunitz's *Flying Fish* (Chapter 7, Figure 7-11). He prepared a baseboard to accept the display case and used the kit's brass pedestals.

BUILDING WAYS AND DIORAMAS

Model Shipways' *Emma C. Berry* (Chapter 3, Figure 3-50) is ideal for displaying on a building way in a shipyard diorama. Omitting some hull planks opens numerous possibilities. John Fryant added walkways and ladders, tools, and model railroad grass. Although invisible in the photo, he even placed nails and hand tools on the walkway.

Many plastic warships are waterline models, so display these in a resin sea for added realism.

DISPLAY CASES

A first-rate ship model should be cased to protect it from dirt and damage. Furthermore, most competitions require entries to be cased. A number of manufacturers sell custom-made acrylic cases; or, check your *Yellow Pages* under "Plastic-Fabricating, Finishing & Decorating." A case's outside dimensions should be at least 4" longer than the model (2" fore and aft), 4" wider (2" port and starboard), and 2" higher. While 1/8" (3mm) thick acrylic is acceptable for models 8" (203mm) or 12" (305mm) long, spend the extra money (it's not much) and order 1/4" (6mm) thick acrylic for anything larger. It can mean the difference between replacing the case or restoring the model. Rounded, polished edges add a that special finished touch to the case. Acrylic, however, scratches easier than glass.

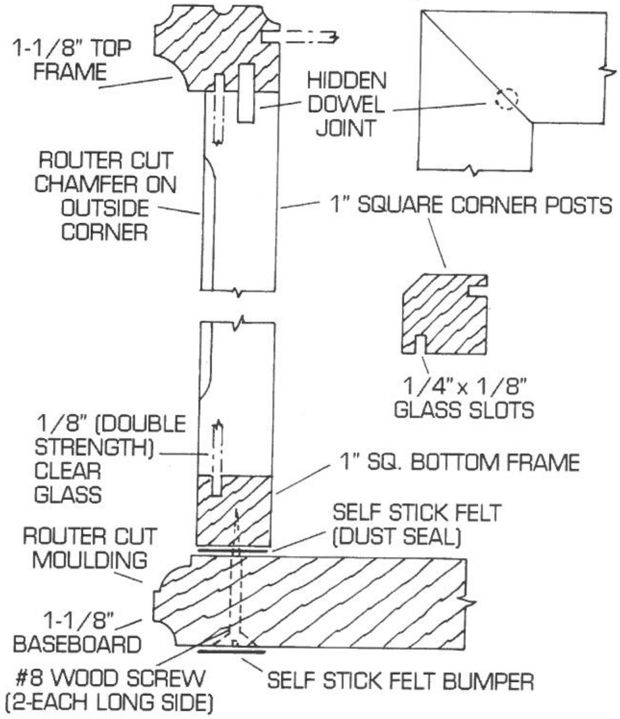


FIG. 8-1 – MODEL CASE

Prefer a glass case? Several model companies sell formed wooden edge pieces for the frame. Order the panes from your local glass specialist. Double strength (1/8") is suitable for 12" long or longer models, while anything smaller can be cased with single strength (3/32" or 2.5mm). For an additional charge, the supplier can provide ultraviolet reflective panes. Be aware that glass is heavier than acrylic and, when broken, sends shards slicing through a model like shrapnel, so specify safety glass.

Given the facilities and tools, anyone can make a case. Figure 8-1 shows a large case for double strength glass. For smaller models, alter the dimensions and use 1/2" (13mm) square wood for the vertical strips. Also, the top strips need not be this fancy. Many of my cases are simply 1/2″ or 3/4″ (19mm) squares. Those with access to a router can fashion an unlimited number of moulding styles for their cases.

Before encasing a model, clean it and the interior of the case. Use Brillianize (also sold as Clear Case) or Novus on acrylic cases to avoid chemicals in some glass cleaners reacting with the plastic. Polish with soft, lint-free cloths. Old, washed underwear works great.

DISPLAY ARRANGEMENT

When setting up your model for display, keep in mind how the real vessel looked. To emphasize scale, try putting some figures on deck. These can be carved, molded, or modified from plastic kits and model railroad layouts. Place barrels, extra spars, and other common shipboard items on the deck, but position them in a realistic manner. Figure 8-2 illustrates Model Shipways' *New Bedford whaleboat* kit. Notice the interesting arrangement of the oars and harpoons. Don't just pile them in the middle of the boat.

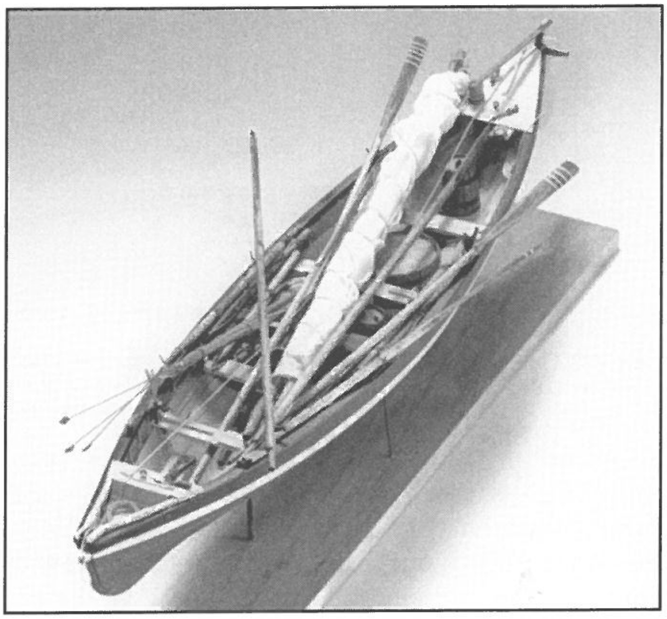


FIG. 8-2 - NEW BEDFORD WHALEBOAT

HAPPY MODELING

All this information should enable you to build a first-rate model from a kit. If the finished product doesn't quite meet your expectations, don't become discouraged. It takes time to gain practical building experience and learn naval architecture. Keep trying and always do your best. Each model will be better than the last. Good luck!

APPENDIX A – REFERENCES

One way to expand your nautical knowledge and become an expert at building quality ship models from kits is to start collecting books and magazine articles on the subject. Establishing a reference library saves time and needless searching. However, recommending "must have" titles from the many available is a difficult task. The following were selected because they contain specific information on subjects not found in other books. Most are available through ship model mail order companies and magazines. Although hobby shops usually stock books on how to build plastic models, larger ones occasionally carry some titles listed below. Mystic Seaport Museum in Mystic, Connecticut, (*www.mystic.org*) has an outstanding book store. Furthermore, Dover Publications, Bonanza Books, and Edward W. Sweetman have reproduced a number of long out-of-print classics.

MODELING BOOKS

These combine historical information on ships with modeling techniques.

Building and Detailing Scale Model Ships by Mike Ashley. Waukesha: Kalmbach Publishing Co., 1996.
Detailed text on assembling plastic models of modern ships. Discusses how to use photoetched brass parts such as ship railings.

Historic Ship Models by Wolfram zu Mondfeld. New York: Sterling Publications, 1989.
Modelbuilding techniques play a minor role in this heavily illustrated superb reference book. Covers practically every aspect of ship construction, outfitting, and rigging from many historical periods. Put it on the top of your list.

How to Build Plastic Ship Models by Les Wilkins. Waukesha: Kalmbach Publishing Co., 1980.
Covers sailing and modern ships. Interesting chapter on how to convert Revell's plastic *Constitution* kit to her sistership *President* using historical references.

The Neophyte Shipmodeler's Jackstay by George F. Campbell. Hollywood: Model Shipways Inc., 1962.
Written especially for the beginner building wooden ship models from kits. Well illustrated and covers many periods.

Planking the Built-Up Ship Model by Jim Roberts. Hollywood: Model Shipways Inc., 1987.
Topnotch publication on how to plank ships from all periods. Designed to help the kit builder if the plans don't show a planking scheme.

The Ship Model Builders Assistant and *The Built-Up Ship Model* by Charles G. Davis. New York: Dover Publications, reprinted 1986 and 1989 respectively.
Two classics for the ship modelbuilder. Although dated, Davis' modelbuilding techniques are still excellent. More important is the wealth of information on how ships were built and outfitted. Many excellent drawings.

Ship Modeler's Shop Notes edited by Merritt Edson, Jr. and others. Nautical Research Guild, 1979.
Valuable collection of shop hints and articles extracted from early issues of the *Nautical Research Journal*. Many quality illustrations, tables, and techniques.

Ship Modeling from Stem to Stern by Milton Roth. Blue Ridge Summit: Tab Books, 1988.
Entertaining text on ship modelbuilding techniques. The chapters on guns and ship's boats are especially useful. Numerous detailed drawings.

HISTORICAL REFERENCES

These books offer nothing on modeling techniques, but are invaluable for their historical knowledge.

The American Built Clipper Ship 1850-1856 by William L. Cruthers. Camden: International Marine Publishing, 1997.
Fascinating text with the best collection of drawings on clipper ship structure and rigging ever assembled. This is Mr. Cruthers' lifetime effort.

American Fishing Schooners by Howard I. Chapelle. New York: W.W. Norton, 1973.
Hundreds of sketches on fishing schooner structure, gear, and rigging make this a valuable asset to anyone modeling these vessels.

Anatomy of the Ship series. London: Conway Maritime Press. Annapolis: Naval Institute Press. Cedarburg: Phoenix Publications.
An excellent series addressing sailing vessels and modern warships. Each book describes only one ship in hundreds of detailed illustrations.

Arming the Fleet by Spencer Tucker. Annapolis: Naval Institute Press, 1989.
A terrific book on naval weapons. Many tables listing cannon and carriage dimensions.

The Art of Rigging by Capt. George Biddlecombe. New York: Edward W. Sweetman Co., reprinted 1990.
Classic text for various early 18th century ships with many tables on rigging and block sizes. Some excellent tables compare the tensile strength of chain and rope line.

The Ashley Book of Knots by Clifford Ashley. New York: Doubleday & Co., 1944.
The best book ever written on the thousands of knots used aboard old sailing ships. Outstanding illustrations.

China Tea Clippers by George F. Campbell. New York: David McKay Co., 1974.
Many detailed drawings of tea clippers, especially deck structures.

Eighteenth Century Rigs and Rigging by Karl Heinz Marquardt. Cedarburg: Phoenix Publishing, 1986.
Thoroughly covers the topic.

Elements of Mastmaking, Sailmaking, and Rigging by David Steel. Largo: Edward W. Sweetman, Co., reprinted 1982.
The original rigging and mastmaking text. Drawings of masts and sails in addition to tables on rigging and blocks for many vessel sizes. This book set the stage for texts by Biddlecombe and Lever.

Encyclopedia of Nautical Knowledge by W.A. McEwen and A. H Lewis. Centreville: Cornell Maritime Press, 1953.
A great reference for nautical terms from A to Z.

Fast Sailing Ships 1775-1875 by David R. MacGregor. Newfoundland: Haessner Publications, 1973.
Excellent historical reference illustrated with numerous drawings. MacGregor is Howard Chapelle's British counterpart. Chapelle introduces the book.

History of American Sailing Ships by Howard I. Chapelle. New York: W.W. Norton, 1935. New York: Bonanza Books, reprinted 1982.
One of the classics. Abundant drawings and descriptions of sailing ships from all periods.

History of American Sailing Navy by Howard I. Chapelle. New York: W.W. Norton, 1949. New York: Bonanza Books, reprinted 1988.
This follow-up to Sailing Ships covers U.S. naval sailing vessels.

Kedge Anchor by William N. Brady. New York: D. Appleton & Co., 1884.
Describes how to rig 18th century naval sailing ships. Complete with tables on rigging and block sizes.

Masting and Rigging of English Ships of War 1625-1860 by James Lee. Annapolis: Naval Institute Press, 1979.
Extraordinary book with many illustrations. Discusses the evolution of rigging items.

Masting and Rigging the Clipper Ship and Ocean Carrier by Harold Underhill. London: Brown, Son and Ferguson, 1946.
Outstanding text with fabulous illustrations for masting and rigging mid 19th century ships.

Origins of Sea Terms by John G. Rogers. Mystic: Mystic Seaport, 1985.
Nautical dictionary also tells how terms originated.

The Oxford Companion to Ships and the Sea edited by Peter Kemp. Oxford: Oxford University Press, 1976.
Another comprehensive lexicon on nautical terms.

The Rigging of Ships in the Days of the Spritsail Topmast 1600-1720 by R.C. Anderson. New York: Dover Publications, reprinted 1994.
A must-have book on early rigging practices. Abundantly illustrated.

Sailing Ships of War 1400-1860 by Dr. Frank Howard. New York: Mayflower Books, 1979.
Well-written text chronicling these ships. Profusely illustrated with some great model photographs.

The Schooner – Its Design and Development from 1600 to the Present by David R. MacGregor. Annapolis: Naval Institute Press, 1997.
Excellent book on schooner development. Several model kit plans used as illustrations.

Seamanship in the Age of Sail by John Harland. Annapolis: Naval Institute Press, 1984.
Excellent book describing how ships were manned and operated. Terrific illustrations.

Search for Speed Under Sail by Howard I. Chapelle. New York: W.W. Norton, 1967.
Covers many sailing ships. Numerous new drawings not found in other Chapelle classics.

The Seventy-Four Gun Ship by Jean Boudriot. Translated by David H. Roberts. Annapolis: Naval Institute Press, 1988.
The first three volumes cover hull construction, fitting out, and masting and rigging. Volume four is devoted to the crew and the way the ship was handled. An outstanding treatise on the art of naval architecture. Beautifully illustration.

Warships in Action series by Squadron/Signal Publications, Carrollton, TX.
Excellent photo publications of modern battleships, submarines, aircraft carriers, destroyers, and PT boats. Great for gleaning details.

Young Sea Officer's Sheet Anchor by Darcey Lever. New York: Edward W. Sweetman, Co., reprinted 1963.
Outstanding book with many illustrations for rigging 18th and early 19th century ships. Great companion to Biddlecomb's tables on rigging sizes.

MAGAZINES

They provide a wealth of information about ship models, building techniques, and ship history.

Fine Scale Modeler (US)

Model Boats (England)

Model Shipwright (England)

Plastic Ship Modeler (US)

Seaways' Ships in Scale (US)

ASSOCIATIONS

These organizations publish outstanding journals. Although primarily focused on maritime history, many articles are about ship models.

Nautical Research Guild (US) – Publishes the *Nautical Research Journal.*

Society for Nautical Research (England) – Publishes the *Mariner's Mirror.*

APPENDIX B - KIT MANUFACTURERS AND DESIGNERS

MANUFACTURERS

The U.S. has seven firms manufacturing wooden ship model kits; A. J. Fisher, BlueJacket Shipcrafters, Dumas, Laughing Whale (a division of BlueJacket), Model Shipways (a division of Model Expo), Midwest Products, and Scientific Models. A. J. Fisher, BlueJacket, and Model Shipways specialize in classic American sailing ships, the modern Navy, and merchant vessels. Dumas designs radio-controlled electric models and is the only licensed manufacturer of Chris-Craft vintage boats. Laughing Whale and Midwest feature numerous American small watercraft kits. Scientific has a line of small, solid hull sailing ship models.

Foreign manufacturers are Amati (Italy), Artesania Latina (Spain), Billings (Denmark), CalderCraft (England), Constructo (Spain), Corel (Italy), Euro Models (Italy), Lesro (England), Mamoli (Italy), Mantua (Italy), Mantua/PanArt (Italy), Mantua/Sergal (Italy), Robbe (Germany), and Steingraber (Germany). PanArt and Sergal were formerly independent companies purchased by Mantua. CalderCraft and Robbe manufacture radio-controlled models of all types, but do market static ship kits. While these firms manufacture kits of some American vessels, they naturally lean toward their own country's historically significant vessels or ship types.

Heller (France) is a leader in quality plastic kits of old sailing ships. Tamiya (Japan) specializes in plastic warships, as does Revell, Revell-Monogram (Germany and US), Airfix (England), Lindberg (US), Glencoe, Blue Water Navy, Gulf Stream, MB Model's, and Tom's Models. Many recent plastic models have resin hulls instead of styrene (plastic) ones.

Although not as large a volume as model aircraft, ship kits and fittings come in a wide range from which to choose. Some are better than others, but at least they are available for the seagoing hobbyist.

DESIGNERS

A book about model kits isn't complete without mentioning some of the dedicated people who research and design them. I don't know them all, but here are a few.

John Shedd, Model Shipways' founder, designed the *Newsboy* and *Dapper Tom* kits. George Campbell, a British naval architect, did *Rattlesnake* and *America*. World-renowned Howard Chapelle developed the first *Sultana*. Erik Ronnberg, Jr., New England watercraft specialist, designed *Fair American*, the schooner *Benjamin Latham*, the New Bedford whaleboat, the whaler *Kate Cory*, the schooner *Elsie*, and the second version of *Newsboy*. Herb Scott contributed the original *Flying Fish*, while Merritt Edson designed the original *Katy*. Bob Evans prepared the drawings for *Prince de Neufchatel* and updated *Katy*. James Berge did *Harriet Lane*. I converted many solid hull kits to plank-on-bulkhead, redesigned the clipper ship *Flying Fish*, developed the skipjack *Willie Bennett* and the Baltimore clipper *Pride of Baltimore II*, updated the Colonial schooner *Sultana*, and designed the sloop *Emma C. Berry*, fishing schooner *Bluenose*, whaler *Charles W. Morgan*, brig *Niagara*, frigate *USS Constitution*, and armed Virginia sloop of 1768.

Erik Ronnberg, Jr. developed BlueJacket's schooner *Smuggler*. Al Ross prepared several modern Navy designs including the Elco 80-foot PT boat. Alan Raven, Paul Hitchcock, and John Ericsson contributed to BlueJacket's merchant fleet and the ironclads. Bill Hitchcock designed the Gloucester schooner from the movie *Captains Courageous*. Canadian Philip Eisnor developed *Bluenose*, and Laurence Arnot gave us *USS Constitution*. Al Montgomery, BlueJacket's original owner, designed many kits including the plank-on-frame *America* and *Jefferson Davis*. Richard Reisdorf presented *Flying Cloud*.

Overseas, the most prolific designer is Luigi Volunte. For 20 years, he produced most of Corel's kits and practically all of Mamoli's. Later, Bruno Volunte prepared several designs under his father's name. Luigi was a World War II fighter pilot before becoming involved in ships.

There are more, of course, and I wish I knew all these dedicated individuals. My hat's off to every one.

APPENDIX C – NAUTICAL TERMS

This is not a complete nautical dictionary (see Appendix A). The following terms are either mentioned in this book or required to effectively interpret ship model plans and instructions. They are grouped in categories and may, therefore, appear in more than one.

Group 1 - general terms
Group 2 - hull structure, planking, and decking
Group 3 - deck furniture
Group 4 - ordinance
Group 5 - anchors and mooring
Group 6 - small boats
Group 7 - masts and spars
Group 8 - sails
Group 9 - rigging

GENERAL TERMS

Abaft: Behind, toward the stern relative to some other object or position.

Aft: Toward the stern.

Amidships or midships: Midway between bow and stern.

Athwartships: Across the ship from side to side.

Beam: Width of the ship.

Bow: Forward part of a ship.

Bright: Stained or varnished wood; not painted.

Draft: Depth of water a ship displaces.

Fantail: A ship's aft section. This is an American term.

Fathom: Six feet. How depth or a length of anchor cable is measured.

Forward: Toward the bow.

Freeboard: Vertical distance at amidships from the upper seaworthy deck or bulwarks to the water.

Knot: A measure of speed. A knot is 1-1/8 miles per hour.

Larboard: Old term for port (left) side.

Leeward: Away from the direction the wind is blowing. It's the ship's sheltered side.

Longitudinal: Structural members running fore and aft.

Port: Left side of a ship looking forward.

Sheer: Curve of the deck line from bow to stern.

Starboard: Right side of a ship looking forward.

Stern: Aft part of a ship.

Transverse: Structural members running athwartships.

Waist: Midships or widest part of a ship's upper deck between the forecastle and quarterdeck.

Windward: Direction from which the wind is blowing.

HULL

Beam: Athwartships timber upon which deck planks are laid.

Bearding Line: Intersection of the hull planking's interior surface with the keel, stem, or sternpost. A bearding line is part of the *rabbet*.

Belts: A group of hull planks. Belts are laid out using *battens* (temporary, flexible wood strips). A *ribband* is also a batten. It supports and holds the frames in position during hull planking. Ribbands are removed as planking progresses.

Billethead: Simple, scroll-like ornament used in place of a figurehead.

Binding Strake: Plank inboard of the waterway on a clipper ship. It's thinner than the waterway, but thicker than deck planks.

Breasthook: Large, horizontal knee across the inboard bow.

Buffalo or *Spray Rail*: Small rail on top of the main rail at the bow.

Bulkhead: Vertical partitions in a ship.

Bulwark: Planking around the *weather* (upper) deck serving as a breakwater. It also prevents sailors from being swept overboard in high seas.

Bulwark Stanchions: Vertical timbers supporting the bulwark planks. These can be separate timbers, an extension of the frames, or timberheads.

Butt: Where the end of two planks meet.

Buttock Lines: In drafting, the longitudinal sections cut vertically through a hull to define its shape.

Camber: Athwartships crown of the deck or deck structures.

Cant Frames: Bow and stern frames not square with the keel.

Carlings: Fore-and-aft timbers between deck beams to enclose openings such as hatches. You may see this term spelled *Carlin*.

Caulk: Oakum and fibers driven between plank seams to make them watertight.

Ceiling: Internal hull and bulwark planking.

Cheeks: Two lowest timbers at the head rails. Shaped like a knee, they fit against the stem and hull. The area between the cheeks was ornately decorated on period ships. The lower ends of the head timbers sit on the upper cheek. Most often, the hawse pipes come out between the two cheeks.

Clamp: Heavy fore-and-aft timbers supporting the ends of deck beams.

Coaming: Raised deck timbers around hatches and cabins. Coamings support other structures and prevent water from running below.

Coppering: Applying copper sheathing to a ship's hull.

Counter: Underside of the overhanging part of the stern.

Covering Board: Planks covering the top of frames like a waterway or planksheer.

Cutwater: Forward side of the stem. On small craft, a deep stem.

Diagonal Lines: In drafting, the longitudinal sections cut diagonally through a hull to define its shape.

Drift Bolt or *Drift*: Metal spike used to attach planking and other structural timbers.

Edge bending: To bend or *spring* a plank edgewise.

Fair: Straight, smooth hull curves.

Fashion Piece: Timbers forming the shape of the stern and usually covering the end grain of the transom planking.

Figurehead: Ornamental figure at the bow.

Forecastle: Raised weather deck at the bow or a crew's living quarters.

Frames: Traverse timbers forming the skeleton of a ship's hull. Hull planking is attached to them. Frames contain *floors* (bottom sections), *futtocks* (mid sections), and *timberheads* (portion projecting above the upper deck). Frames were double (made in two halves) with overlapping joints.

Freeing Ports: Large openings in the bulwark to clear a swamped deck. Port doors were hinged at the top and forced outboard by water pressure at the bottom. Large ships had one to three freeing ports per side.

Galley: Where meals are prepared on a stove that exhausts through a stovepipe or stack.

Gangway: Opening in the bulwark for leaving the ship via a ladder or ramp. Also, a platform connecting the forecastle and poop decks.

Garboard Strake: Length of plank adjacent to the keel.

Gunwale (pronounced *gun-el*): Uppermost plank in a hull. Also, the upper edge or rail of a small boat.

Head: Area forward of the hull containing the crew's toilets, square wooden seats (also called *seats of ease*). Landlubbers adapted the phrase to mean the men's lavatory.

Head Rails: Fancy curved rails at the head for supporting a long stem.

Head Timbers: Transverse supports from the stem to the head rails.

Keel: Ship's backbone. Longitudinal timber or timbers at the bottom of the hull.

Keelson: Timber(s) bolted on top of the keel, or the frames above the keel, to reinforce it.

King Plank: Thick deck plank or planks on a ship's centerline.

Knightheads: Two heavy, vertical timbers, one on each side of the bowsprit. A knight's head was often carved into the top of these timbers; hence, the name.

Lashing Rail: Batten nailed to the inside of the bulwark stanchions for belaying lines. Common aboard whalers.

Main Deck: Uppermost deck. Also called the weather or spar deck.

Main Rail: Largest topside rail on a bulwark.

Margin Planks: One or two continuous deck planks alongside the bulwark. The inboard margin plank is usually the *nibbing* plank.

Middle Line: Line between the rabbet line and bearding line.

Molded and Sided Dimensions: Plans may show a timber molded 12″ and sided 6″. The molded dimension is the depth of a beam, the keel, or a perpendicular frame. The sided dimension is their width (a longitudinal or transverse measurement). However, a structural member molded 6″ and sided 12″ is wider than it is deep. Don't think a beam should be deeper than it is wide. Doing so creates confusion.

Molding or *Moulding*: An embellished wooden strip used to decorate around the top of cabins or other structures.

Monkey Rail: Light rail on top of the main rail (*monkey board*) aft of the deck step at midships. Although similar to a topgallant rail, the term is used only on fishing schooners.

Nib: Pointed end of a tapered plank. Because nibs rot first, shipwrights squared them off, then notched the margin plank (covers outer edge of deck) to accept the butts. Consequently, they called the margin plank the *nibbing* plank.

Nibbing: Process of seating the squared, tapered end of one plank into the edge of another. Nibbing generally applies to decks, but sometimes hull planks, especially at the bow, are nibbed. The British call this procedure *joggling*.

Partners: Slightly raised timbers strengthening the deck where a mast, capstan, pump, or bowsprit pierces it. Partners close the opening.

Plank: Single length of wood fastened to the outside of a ship's frames or to beams to form decks. A planking *strake* is a continuous line of planks butted against each other from bow to stern.

Planksheer: Large timber placed over waterways in clippers and other large vessels, but may replace waterways on smaller ships.

Poop Deck: Raised deck at the stern.

Quarter: Part of a ship's side forward of the stern and aft of the mizzen rigging. *Quarterdeck* is that part of the upper deck from the mainmast to the poop (also called the poop).

Rabbet: Groove cut into the keel, stem, or sternpost to receive planking. The *rabbet line* is the intersection of the planking's outer edge with the keel, stem, or sternpost (also see bearding and middle line).

Rail: Timber covering the top of the bulwarks.

Scantling: Dimensions of timbers forming a ship's structure.

Scarf Joint: Beveled joint. It's stronger than a butt joint.

Sheathing: Wood or copper covering on a vessel's bottom to protect it from marine borers.

Sheer Strake: Uppermost line of planking on a hull.

Shoe: Plank projecting from the bottom of the keel. It isn't always completely painted during dock, so may start to rot and is therefore replaceable.

Spar Deck: Upper or weather deck of a naval vessel.

Spiling: Marking and cutting a plank's edges to a given shape.

Station Lines: In drafting, the vertical sections cut transversely through a hull to define its shape.

Stealer: Plank inserted into another plank or between two adjacent planks to reduce their width. Or, when two planks taper toward a narrow end, both may have to be cut off and a wider plank substituted to leave enough wood for fastening to the frames.

Stem: Foremost timber in a vessel. It is joined to the keel and usually tapers upward.

Sternpost: Vertical timber erected on the aft end of the keel. The rudder is attached to it.

Stringer: Longitudinal stiffener in a ship's hull.

Thick Plank: Thicker deck planking reinforcing heavy load areas. *Doublers* over normal planking do the same thing.

Topgallant Rail: Short rail with vertical section above the main rail and extending the freeboard. Timberheads or bulwark stanchions may extend above the main rail, and the stanchions planked to form the sides of the topgallant rail. The cap rail is then placed on top.

Transom: Curved or flat portion above the counter.

Treenail: Wooden pin for attaching hull planking to the frames or for joining any two timbers.

Wale: Heavy strake running below the sheer strake. Several plank thicknesses may compose the wale or wales.

Waterlines: In drafting, the horizontal sections cut through a hull to define its shape. A ship floats at the waterline or load waterline.

Waterway: Thick wooden gutter along the side of the deck. It catches and carries off water through *scuppers* (drains) at its base.

Weather Deck: Uppermost deck. Also called the spar or main deck.

DECK FURNITURE

Air Port, Port Light, or *Port Hole*: Round openings with glass windows. Some open; some don't.

Belfry: Structure from which the ship's bell is suspended.

Bilge Pump: Brings up bilge water. *Brakes* (handles) on large pumps are secured to the fife rail or a separate frame. Pumps can have from one to six chambers.

Binnacle: Box or nonmagnetic metal container for the ship's compass. Originally, lanterns lit the compass, while vents exhausted the smoke.

Bitt: Wood or metal post for securing mooring lines, rigging, or anchor cables. Usually fitted in pairs. Steel bitts may have a single, double, or triple post on a common base. Bitts are named by their function, so you may run into terms such as *Quarter Bitts* (mooring bitts aft), *sheet bitts* (for belaying topsail sheets), and *Riding bitts* (for securing anchor cable).

Bollard: Mooring bitts used on a ship or on a wharf. Usually metal.

Cabin Trunk: Extension of a cabin above the deck.

Channels: Broad, flat boards projecting horizontally from the ship's sides to spread the shrouds and hold the chain plates away from the hull.

Charley Noble: Nickname for the galley's smokestack.

Chock: Iron casting for leading lines over a rail. Can be an open (cut out on top), closed, or roller chock.

Cleat: Wood or iron fitting with two horns for belaying rigging and mooring lines.

Companionway: Protective structure covering a stairway or ladder leading below decks. It may have a door or sliding top.

Deck Lights: Small prisms in the deck to let light into the ship.

Fife Rail: Rail around masts with pins for belaying rigging lines. The crosspiece or fife rail was attached to heavy bitts or supported by round or square stanchions.

Gallows: Bitts with crosspieces for supporting spare spars stowed fore and aft on a weather deck. May also support ship's boat and be called *Boat Gallows*.

Garland or *Shot Rack*: Rack for stowing cannonballs.

Grating: Openwork covering hatches to allow air circulation throughout the ship. Gratings also were used over the galley stove opening to exhaust smoke.

Gudgeon: Yoke bolted to the sternpost with an eye to receive a corresponding pintle on the back of the rudder.

Hammock Rails: U-shaped iron cranes mounted on a naval vessel's main rail. Railings were of rope or wood into which an open net was secured and the crew's hammocks tightly packed. This protected the men against musket balls and caseshot fire.

Horse Block: Small, elevated platform on a naval vessel's quarterdeck from which the officer of the watch gave orders and viewed enemy action.

Ladders: Vertical, inclined, or curved steps for proceeding below deck, to cabin roofs, or over the bulwark.

Pin Rail: Horizontal rail on the bulwarks with pins for belaying lines.

Pintle: Yoke bolted to the back of the rudder with a vertical pin that fit into a corresponding gudgeon. This formed a hinge on which the rudder pivoted.

Preventer: Chains attached to the hull and rudder to prevent a heavy sea from sweeping it away.

Quarter Gallery: Balcony projecting from the quarter of a sailing naval vessel or large merchantman. Has windows and may contain the officers' head.

Riding Bitts: Large wood or metal posts to which the anchor cable was secured. Used before the windlass was invented.

Samson Post: Vertical timber inboard of the bowsprit. Often has a windlass secured to it.

Scuppers: Drains in the waterways of the main or weather deck.

Sea Steps: Steps on the side of the hull for climbing on board from a boat.

Ship's Wheel: Spoked wheel with handles for operating the rudder through various steering mechanisms.

Skylight: Deck structure with windows in the roof or sides for allowing light and air below. It is often covered with closely spaced bars to protect the glass.

Stanchions: Vertical, round or square pillars for supporting rails or the bulwarks if timberheads aren't present.

Sweep Ports: Openings in the bulwark for *sweeps* (long, heavy oars). Sweep ports are smaller than gunports.

Taffrail: Ornamental rail along the upper edge of the stern. It's usually supported by square or round stanchions.

Tiller: Wooden or iron bar for turning the rudder.

Trailboards: Carved boards leading aft from the stem to either side of the hull. They replaced the head cheeks when ostentatious figureheads fell out of vogue. Today, trailboards sometimes decorate the bows of modern sailing yachts.

Ventilators: Pipes for directing air into the hull.

ORDNANCE

Boarding Pikes: Spear-like weapons designed to repel an enemy boarding party. Pikes were stowed in racks around masts or elsewhere on the ship.

Breeching: Heavy line seized to ring bolts in the ship's side to absorb a cannon's recoil when fired.

Cannon: Large, mounted a naval weapon that fires a heavy projectile. Cannon include carronades, long guns, and mortars. Cannon were generally described by the weight of shot fired, such as a 32-pounder or pdr.

Carronade: Short, light cannon with a large bore used at close range (less than 300 yards). Popular during the 1790s, but out of fashion by 1815. Carronades required a smaller gun crew than the cannon.

Gun Carriage: Wheeled support for a cannon. Long guns usually had a wooden carriage. The carriage consisted of *cheeks* (sides), front and rear axle trees, *trucks* (wheels), *transom* (front support), *buffer* (front bumper), *stool bed* (base), *bed block* (back support), *cap squares* (metal bands clamping the trunnions to the cheeks), and *quoin* (tapered, right-angle block placed under the breech to elevate a cannon). Although some carronades were mounted on simplified standard ship carriages, most were on special carriages made by the Carron Company and supplied with the weapon. The *bed* (upper part) held the gun and enabled it to be elevated and depressed. A bolt attached the bed to the slide or *training bed*, which allowed it to recoil. The slide rotated on a pivot at its forward end and had two, small iron trucks at the rear.

Gun Deck: On warships, the deck below the weather or spar deck containing the large cannon.

Gunport: Opening in a ship's sides or bulwarks for running out the cannon. Most were covered with a hinged lid.

Gun Tackle: Originally, the lines on a cannon. Also, a *purchase* (tackle) consisting of two single blocks and the necessary line.

Swivel Gun: Small, breech or muzzle-loading gun fitted on a forked piece of metal with the pin set into a rail or bitt. They were fired over the rail, from the fore and main tops, or from boats. Remained in used until 1815.

Train Tackles: Lines used to maneuver a gun carriage.

Truck: Wheel on a gun carriage.

Trunnion: Projecting pin on each side of a cannon barrel to pivot it backward onto its breech. Cap squares clamp the trunnions to the cheeks.

ANCHORS AND MOORING

Anchor: Heavy iron implement dropped from a ship to hold or alter its position. The anchor's two *palms* or *flukes* (flat pointed pads) grab the sea bed. Besides the palms, an anchor consists of the *shank* (main shaft), *crown* (part where the arms join the shank), *bill* (tip of the palm), and a wooden or metal *stock* (crosspiece at the top of the shank) The stock is at right angles to the palms to force them into the ground when the anchor hits bottom.

Anchor Deck: Forward deck on a whaler similar to a forecastle deck.

Anchor Release: Device fitted on a cathead to quickly release the anchor.

Billboard: Any support upon which the bills or palms of an anchor rest. Prevents chafing the hull or deck.

Bollard: Mooring bitts used on a ship or on a wharf. Usually metal.

Bower Anchor: One of two heavy anchors with wooden stock stowed at the hawse pipe and used primarily for anchoring. They were carried at the starboard and port bows; hence, it's name.

Brakes: Handles on a manually-operated deck pump or windlass.

Cable: Heavy rope or chain attached to an anchor.

Capstan: Vertical drum-like machine to heave rope or chain. *Whelps* (wood or metal strips) around the spindle grabbed the line, while *pawls* (hinged pieces of iron) at the base prevented the capstan from rotating backward. Sailors pushing on bars inserted into square *pigeon holes* in the head manually turned the device. Later, steam or electric power revolved it. Naval vessels usually carried capstans, while merchantmen used windlasses.

Capstan Bars: The eight to 10 wooden bars sailors used to turn a capstan.

Carrick Bitts: Upright projecting timbers, generally with knees, supporting the shaft of a windlass. Also known as *windlass bitts* or *carrick heads*.

Cathead: Short, port and starboard wood or iron beams projecting over the bow for raising an anchor.

Cavil: Large, fore-and-aft cleat for belaying heavy lines. Also called *kevel, kevil,* and *cavel*.

Chain Pipe: Covered casting in the deck through which the anchor chain led to the locker.

Chain Stopper: Security device to prevent an incoming anchor chain from going overboard should the capstan or windlass fails.

Cleat: Wood or iron fitting with two horns for belaying rigging and mooring lines.

Grapnel: Small, four- or five-pronged anchor dragged to locate objects or anchor small boats.

Hawse Pipe: Iron casting in the bow through which the anchor chains run.

Hawse Pipe Lip: Ring around the exterior portion of the hawse pipe to prevent the anchor chain from chafing.

Hawser: Heavy line (five inches or more) for mooring and towing.

Kedge: Light anchor with an iron stock. Usually the smallest anchor on board, it supports the bower anchor whenever the vessel's stability is threatened. Also used to move a ship from one berth to another *(kedging)*.

Mooring Chocks: Large, oblong, closed chocks in the hull through which mooring lines pass.

Pawl: Short, hinged, iron strut on a windlass, capstan, or winch head. As the machine rotates, the pawl slides over and engages the teeth, preventing the equipment from turning backward.

Pawl Bitt: Large wood or metal post or samson post on the centerline. It supports the windlass' pawl.

Riding Bitts: Large wood or metal posts to which the anchor cable was secured. Used before the windlass was invented.

Sheet and *Steam Anchors*: The sheet anchor, carried in the waist, was the largest aboard and always ready for use. The steam anchor was a spare.

Staghorn: Another name for a cavil, but shaped like a bull's horns. Used on early ships for belaying lower sheets or mooring lines.

Warping Drums: Portion of the windlass projecting beyond the carrick bitts. Drum head is larger toward the windlass and curved in the middle. Wrapped lines around the drum provided a mechanical advantage. Warping drums were hand operated in the old days, but are electrically powered today.

Whelps: Wooden or metal strips around a windlass or capstan to prevent the anchor cables from slipping or chaffing.

Windlass: Horizontal winch on the centerline for lifting anchors. Whelps were starboard of the barrel, but sometimes a windlass had whelps for chain on one side and for cable on the other. At the center were two large ratchet gears with pawls. Each gear had a *quadrant* (arm) connected via links to a *rocker* (pump arm). Rockers and pawl were fixed to a pawl bitt or samson post. *Brakes* (pump handles) were fitted to the rockers. Windlasses often had warping drums. Carrick bitts with *standards* (knees) supported the windlass. While most windlasses were originally hand operated, they were modified in later years to run on steam or electricity. Merchantmen carried the windlass, while naval vessels preferred the capstan.

SMALL BOATS

Barge and *Yawl*: Round-bottomed cargo boats and personnel ferries 25 to 35 feet long with eight to 16 single- or double-banked oars.

Bearers: Vertical lashing posts between davits used to tie off boat gripes. Common on whalers.

Benches: Curved seats in a boat's stern for officers and important people.

Bow or *Head* and *Stern Sheets*: Platform or seats at the bow and stern.

Carvel Planking: Flush-sided hull planks set edge to edge on frames and caulked.

Centerboard: Wide, keel-like board hoisted or lowered through a watertight *trunk* (well) to provide stability and tracking. A *leeboard* worked similarly, but was suspended from the vessel's lee (port) side.

Chine Log: Longitudinal timber to which the flat sides and bottom of a V-bottom boat were attached. This intersection is the *chine*. A Chesapeake Bay skipjack is a V-bottom boat.

Clamp: Longitudinal stringer supporting the deck beams, washboard, or cabin beams on a small boat.

Clinker Built or *Lapstrake*: Lower edge of a hull plank overlaps the upper edge of the one below it.

Cranes: Type of davit made from hinged wooden brackets that swung out to support a whaleboat on an American whaleship. Boats were lashed to the cranes.

Cuddy: Small storage closet under the bow or stern seats in a whaleboat.

Cutter and Pinnace: General purpose, clinker-built, round-bottomed boats that were usually smaller than a longboat or launch. They were 20 to 50 feet long and equipped with a dozen or more double-banked oars.

Davit: Curved or straight-arm crane for lifting, lowering, and storing ship's boats. Stern davits were at the stern and quarter davits were at the aft side of the ship.

Dinghy: Smallest ship's boat. It was generally clinker built, 10 to 15 feet long, and equipped with a pair of oars.

Dory: Small, flat-bottomed, 16- to 20-foot-long boat with angled sides. Used most often by a one- or two-man crew for fishing. Equipped with two or four oars. On fishing schooners, the thwarts were removed and the boats nested inverted on deck.

Double-banked Oars: One port and one starboard rower per thwart.

Floor or *Bottom Boards*: Longitudinal planks laid in the bottom of a boat over its frames. Spaces between the boards drained water.

Gig: Narrow, fast, 20- to 28-foot-long round-bottomed boat equipped with two or three pairs of oars. When used by a ship's captain, it was called the *captain's gig.*

Gripes: Flat straps crossing diagonally over the outside of a boat to hold it against its davits.

Griping Spar: Long spar between the davits for securing boat gripes.

Guard or *Rubbing Strake*: Exterior wooden moulding on the gunwale to protect a boat's hull from chafing when alongside a dock or another vessel.

Gunwale (pronounced *gun-el*): Uppermost plank in a hull. Also, the upper edge or rail of a small boat.

Launch and *Longboat*: Largest service boats carried aboard a ship. Round-bottomed, 20 to 50 long, with 12 to 18 double-banked oars.

Lifting Rings: Large rings at the bottom of a boat's bow and stern for hoisting it out of the water.

Oar: Long, thin, usually wooden pole used to row or steer a boat. It consists of a *blade* (flat extremity in the water), *shaft* (long, round section), and *loom* (hand grip) inboard of the rowlocks.

Painter: Line in the bow for mooring or towing a boat.

Quarter Boats: Any boat in the quarter davits.

Riser. Longitudinal stringer along a boat's interior for supporting the ends of the thwarts.

Rowlock: U-shaped cutout in a boat's gunwale acting as a fulcrum for the oars. *Thole pins*, two wooden or metal pins in the gunwale, often replaced the rowlock. The modern U-shaped metal swivel is called a *crutch, oarlock,* or rowlock.

Single-banked Oars: One man per thwart staggered port to starboard, or one behind the other as in a racing shell.

Skeg: Narrow extension below the keel at the stern and fitting into the sternpost. Generally found on flat- and V-bottomed boats.

Slides: Vertical battens on a boat's hull that prevent it from catching on the rails.

Sole: Cabin floor of a small boat.

Stern Boats: Any boat in the stern davits, usually the captain's gig.

Thwart: Athwartships seat in a small boat.

Washboard: Thin shelf along the sides of the gunwale to prevent water from coming on deck. Most common on small, open workboats.

Whaleboat: Double-ended, round-bottomed, 25- to 30-foot-long service boat equipped with five single-banked oars. Some whaleboats had centerboards. Found on whalers and naval vessels.

Yoke: Transverse board mounted on a boat's rudderhead and fitted with lines to control the rudder. When a yoke was used, the tiller was either absent or very short.

MASTS AND SPARS

Band: Any metal bar around masts, yards, booms, and gaffs with eyes or other fittings for attaching blocks, hooks, futtock shrouds, and other rigging equipment.

Bees: Wooden block on either side of the bowsprit through which the fore topmast stays rove back to the bow.

Bibbs or *Cheeks*: Heavy wooden knees bolted a short distance below the top of a mast to support the trestletrees.

Bolster: Quarter rounds resting on the trestletrees to prevent the shrouds from chafing or taking too sharp a bend.

Boom Crutch: Vertical timber with a "U" at the top for resting the booms of small fore-and-aft rigged vessels while in port.

Boom Jaw Rest: Wooden ring or partial ring supported by small chocks on a mast for resting the boom's jaws.

Bowsprit: Heavy spar protruding from the bow to support the forestays.

Bumpkin, Bumkin, or *Boomkin*: Short boom projecting from the ship's side for securing the fore tack block or one of the main brace blocks.

Cap: Two-holed wooden or metal fitting for joining the masthead of one mast to the heel of another, or the bowsprit to the jibboom. The cap can also have eyes and blocks.

Chesstree: Short timbers mounted vertically on each side of the ship for holding the main sheet lead blocks. The term also describes a sheave in the bulwark through which the main sheet roves.

Clapper: Vertical wooden block pivoting on a pin between the jaws of a gaff. Also called a *tongue* or *tumbler,* it made the gaff slide up and down more easily and prevented it from jamming. Not all gaffs had one. Clappers were mostly on modern craft such as fishing schooners.

Crane Iron: Iron rod on a mast for holding the throat halliard blocks. Mostly found on schooners.

Crossjack Yard: Lower yard on the mizzenmast.

Cross-trees: Transverse beams or struts supporting mast tops and spreading shrouds.

Doubling: Area where the heel of an upper mast overlaps a lower mast.

Fid: Slender iron or wooden block inserted in a hole at the heel of a topmast or topgallant mast to support it on the trestletrees.

Futtock Band: Metal band with eyes below the mast top for attaching the lower ends of the futtock shrouds.

Futtock Stave: Rod or batten to which the futtock shrouds seized if they didn't secure to the futtock band.

Gaff: Spar on the aft side of a mast supporting the head of a fore-and-aft sail.

Gooseneck: Swivel that secured a boom to a mast band.

Hounds: Wooden shoulders on either side of an upper masthead supporting the trestletrees.

Jackstay: Wire rope, metal rod, or wooden batten fastened to the upper side of a yard or spar to which the head of a square sail was attached or footropes lashed.

Jaws: U-shaped projection at the end of a boom or gaff that fit against a mast. A rope or rod parrel held the spar to a mast.

Jibboom: Spar secured to and extending forward of the bowsprit. The *flying jibboom* was another extension.

Lubber's Hole: Large opening in the lower mast top through which running rigging rove. Also, a man could climb through it instead of scrambling over the edge of the top.

Made Mast: Any mast fabricated from several logs tied together.

Martingale or *Dolphin Striker*: Vertical strut below the bowsprit cap. It increased the downward pulling force of stays going back to the bow.

Mast: Vertical spar supporting yards and sails. The *foremast* was the foremost one, followed by the *mainmast* and *mizzenmast* on a three-masted ship. Each contained a lower mast, topmast, topgallant mast, royal mast, and sometimes a skysail mast.

Mast Coat: Canvas or other material covering the mast wedges and making the deck joint watertight.

Masthead: Portion of mast from the trestletrees to the cap.

Parrel or *parral:* Rope with wooden balls or other devices securing a yard, boom, or gaff to a mast.

Rake: Angle of a mast to the perpendicular.

Saddle or *Yoke*: Wooden truss on a yard shaped to fit a mast. A parrel held the yard against the mast. Saddles were used after the rope truss went out of style.

Spanker Mast: Separate smaller mast abaft the mizzen. It carried the spanker's mast hoops.

Spar: Any pole used for rigging; i.e., yards, booms, gaffs, bowsprit, jibboom, etc.

Spencer Mast: Separate smaller mast abaft the fore and mainmasts carrying the *spencer's* (trysail) mast hoops.

Spider Band: Heavy mast band fitted with holes for belaying pins.

Spreader: Spar for spreading the upper shrouds and backstays. On some ships, spreaders and cross-trees were basically the same. However, the spreader was a separate, longer spar extending beyond the cross-trees on a clipper.

Studding Sail Boom Irons: Iron fittings with rings on yards. When not in use, sailors slid the studding sail booms through these rings.

Top: Platform resting on a lower mast's trestletrees and cross-trees. It help spread the upper rigging and, on warships, was where marines stood to fire small weapons at the enemy. Often called the *fighting top*.

Trestletrees: Short, longitudinal timbers on each side of a lower mast's head. They supported the cross-trees, top, and the heel of the topmast.

Truck: Ball or other object atop the uppermost mast. Often had a sheave or hole in it for the flag halliards.

Truss Iron: Iron rod between a yard and mast band or parrel. It secured the yard to the mast.

Tub Parrel: A lined, circular tub around a mast to which the yard truss was attached. Used mostly on the upper topsail yards of a double topsail ship.

Yard: Spar supporting a square sail.

Yardarm: Outer end of a yard beyond the shoulder or fitting for the lifts.

SAILS

Bend: To lace a sail to a spar or jackstay.

Boltrope: Reinforcing rope laced around the edge of a sail.

Bonnet: Extension laced to the foot of a sail to increase its size.

Clew: Lower corners of square sail or the aft corner of a fore-and-aft sail.

Course: Lowest square sail on each mast.

Cringle: Iron strop, rope strop, or grommet at the corners of a sail for attaching sheets, tacks, and other running lines.

Crossjack: Another name for the mizzen course.

Furl: To bundle and lash a sail to its yard or boom when not in use.

Gaff Topsail: Triangular sail set from the topmast and gaff of a fore-and-aft rigged ship.

Grommet: Ring and lacing around a hole in a sail.

Head: Top of a square sail or the top corner of a triangular fore-and-aft sail.

Jib: Large, triangular fore-and-aft sail at the bow. A *flying Jib* can go ahead of the jib.

Leech: Sides of a square sail or the aft side of a fore-and-aft sail.

Luff: Forward side of a fore-and-aft sail.

Reef: To shorten a sail in heavy weather.

Reef Band: Reinforcing canvas band with holes for the reef points.

Reef Points: Short lines in the reef band for tying the sail to its boom or yard.

Ringtail: Extension sail abaft a spanker.

Royal: Square sail above the topgallant.

Seams: Lines where the bolts of cloth were sewn together to form the sail.

Skysail: Square sail above the royal.

Spanker or *Driver*: Fore-and-aft sail set on a gaff abaft the mizzenmast. Could also have a boom.

Spencer: Fore-and-aft sail set on a standing gaff abaft the fore and mainmasts.

Spritsail. Square sail set on a yard on the bowsprit.

Staysail: Fore-and-aft sail rigged on the mast stays.

Studding Sail (pronounced *stun-sul)*: Light sail added outboard of a square sail to increase its total area.

Tabling: Hem around a sail.

Tack: Forward lower corner of a fore-and-aft sail.

Topgallant: Square sail above the topsail.

Topsail: Square sail above the course. Some ships had double topsails, two smaller sails in place of a single one. Howe developed this system in the 1850's to permit easier handling of the sails.

RIGGING TERMS

Backropes: Ropes that continue from the stays back to the bow after the stays pass the dolphin striker.

Backstays: Lines supporting the masts from fore-and-aft forces.

Baggy Wrinkle: Mat made of rope yarn and wound around rigging lines to protect the sails from chafing.

Becket: Eye on a block for securing a line's standing end.

Belay: To secure a running line to a cleat or belaying pin.

Blocks: Wooden or metal shells with sheaves through which lines rove.

Bobstays: Chains or ropes supporting the bowsprit from upward loads.

Bowsprit Shrouds or *Guys*: Transverse support lines for a bowsprit.

Braces: Lines attached to the yardarms. They set the angle on a yard and held it taut.

Brails: Lines that pulled a loose-footed, fore-and-aft sail toward the mast for furling.

Breast Backstay: Supplemental shroud with running tackle fitted outside the regular shrouds. Often used to stiffen the topmasts.

Bowlines: Lines attached to the sides of a square sail to pull it forward. These were used primarily on 18th century and older ships.

Bullseye: Similar to a deadeye except it has one large hole.

Buntlines: Lines that pulled up the belly of a sail for furling.

Catharpins: Lines used to tighten loose hemp shrouds. Catharpins were generally at the intersections of the futtock staves.

Chain plates: Iron bar or rod along the hull that held the shroud deadeyes.

Clew Garnet: A clew line used on the lower yards.

Clew Lines: Lines that pulled up the corners of a square sail.

Clump Block: Oval block for staysail sheets. It didn't tear a sail if it rubbed against it.

Collar: Standing rigging eye passing over the masthead.

Crane Lines: Footropes across the lower shrouds on which sailors stood when furling main staysails and the spanker. These lines were a recent development.

Deadeye: Round wood block with three holes for reeving a lanyard. Metal turnbuckles have replaced deadeyes on modern ships.

Downhauls, Outhauls, and *Inhauls:* Lines that hauled a sail along a boom, or up and down a stay.

Fairlead: A block with a hole or holes used to lead lines in a certain direction.

Flemish Horse: Short footrope at the yardarms.

Footrope or *Horse*: Line under yards and bowsprit on which sailors stood to furl the sails.

Futtock Shrouds: Short lengths of ropes or metal rods that supported the topmast rigging. They led from the futtock plate to the futtock band. If they went only to the lower shrouds, they generally tied to a wooden or metal rod called a futtock stave.

Gasket: Short length of line for furling a sail.

Guys: Lines supporting the jibboom and bowsprit from side forces, or any stay such as a boom guy or boat davit guy.

Halliard or *Halyard*: Line for raising and lowering a sail, yard, boom, gaff, or flag.

Horse or *Footrope*: Line under yards and bowsprit on which sailors stood to furl the sails.

Jeers: Heavy tackle for hoisting a lower yard.

Jig Tackle: Purchase of blocks and rope at the working end of a rig.

Lacing: Small ropes for lashing sails to booms and gaffs.

Lanyard: Line roving through deadeyes, bullseyes, or thimbles for tightening rigging.

Lashing: To fasten by wrapping with line.

Leechlines: Lines that pulled up the side of a sail.

Lifts: Standing or running lines that angled or lowered yards.

Manropes: Safety lines at the bowsprit and other areas. Usually a line to hang onto rather than walk on.

Martingale Stays: Lines under the bowsprit and jibboom roving through a dolphin striker.

Mouse: Knob of rope that prevented an eye from sliding along a line.

Moused Hook: Lacing around the end of a hook to prevent it from falling out of a fitting.

Parrel or *parral:* Rope with wooden balls or other devices that secured a yard, boom, or gaff to a mast.

Peak Halliard: Outer line on a gaff.

Ratlines: Footropes on shrouds.

Reef Tackle: Lines that hoisted or lowered a sail to its spar for reefing.

Running Backstay: Movable line with a tackle on deck.

Running Rigging: Lines that moved, rove through blocks, or operated sails and spars.

Seizing: Wrapping small cord around two lines to bind them.

Shackle: U-shaped iron fitting with a removable pin.

Sheaves: Roller in a block or structure over which lines rove.

Sheer Pole: Round or rectangular iron or wood bar seized to the shrouds just above the deadeyes to maintain the shrouds' spacing. A sheer pole was occasionally a belaying point.

Sheets: Lines that held the lower corners of a sail or boom.

Shrouds: Transverse lines that supported the masts.

Sister Block: Double sheave block with the sheaves in line.

Sling: Short, heavy line or chain that took the weight of a yard at the mast.

Standing Rigging: Stationary lines that supported masts and spars. Generally, standing rigging was tarred; hence, it was black or dark brown.

Stays: Fore-and-aft standing lines that supported the masts.

Stirrups: Short lines that supported the footropes.

Strop: Rope or iron bar around a block.

Swifter: Foremost lower mast shroud.

Tack: Line at the lower corners of a sail. On a fore-and-aft sail, the tack was at the forward lower cringle. On a square sail, the tack led forward and the sheets led aft.

Tackle or Purchase: Several blocks and a line providing a mechanical advantage for handling sails and spars.

Throat Halliard: Forward line on a gaff at the jaws.

Topping Lift: Line that held up the boom when the gaff was down or absent.

Truss: Rope or iron fitting that held a yard against its mast.

Tye: Part of a halliard attached to a yard.

Vangs: Port and starboard lines that prevented a gaff from swinging sideways.

Worming, Parceling, and *Serving*: First, a small line was laid between the strands of a rope, then the rope was wrapped with canvas strips, and finally wrapped with another rope or wire. This process protected standing rigging from chafing.